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ABSTRACTS – POSTER PRESENTATIONS

Note:

- The abstracts in this booklet have been directly copied from the author(s), and the Local Organising Committee have not edited them in any way.
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1. AGNEW, Philippa

Pre-breeding foraging ranges of little penguins as an indicator of lay dates

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Oamaru Blue Penguin Colony, Oamaru, New Zealand

Abstract: Results from the long-term monitoring of a little penguin (*Eudyptula minor*) population in Oamaru, New Zealand, indicated breeding success rates that were amongst the highest documented for the species. A significant correlation between breeding success (measured as the number of chicks fledged per female) and the proportion of females producing a double brood was observed. Double brooding was related to the date of the onset of egg-laying; earlier egg-laying lead to a higher likelihood of birds double brooding. Lay dates are therefore critical in determining the reproductive output each breeding season. The current study investigated the pre-breeding foraging behaviour of the penguins during 2018, in order to determine how foraging range and effort related to the date of first eggs being laid. During May birds predominantly foraged within 10 km of the breeding colony, with occasional trips to a maximum distance of 17 km. Trips were single-day in duration with tracked birds returning to the colony every evening. In June, however, the penguins foraged at a greater distance; the furthest an individual was recorded being approximately 95km to the north east of the colony. Near-shore foraging during May suggested there was an abundant food supply close to the colony, which was probably the precursor to early egg laying. Egg-laying occurred 20 days earlier in the 2018 season (26 June) than the long-term average.

2. ALLARD, Stephanie

Ensuring penguins are thriving ex-situ and in-situ

Authors: Stephanie Allard, Grace Fuller and Matthew Heintz

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Abstract: The zoo and aquarium community has been evolving beyond providing care to captive animals to ensuring individual animals are thriving. The Detroit Zoological Society (DZS) constructed the Polk Penguin Conservation Center using a welfare-driven design. To assess the impacts of this large and complex habitat on penguin welfare, The DZS's Center for Zoo and Aquarium Animal Welfare and Ethics began a multi-year study in 2014. A comprehensive approach, incorporating behavioral observations, endocrine and physiological measures, and the use of technology such as data loggers and infrared thermography, has greatly increased our ability to measure welfare indicators in captive penguins. An issue central to animal welfare is that of giving animals meaningful choices and control over aspects of their lives. Results of the study demonstrate that, for example, the king penguins spent up to ten more times engaged in water-related behaviors in their new habitat which featured significantly more water space. This suggests that animals will engage in highly motivated behaviors if given the opportunity to do so, based on more than just survival need. The methodology and results of this study have strong implications for both captive and wild penguins. Measures of responses to anthropogenic impacts are central to animal welfare science, and many of the issues facing wild penguins are caused directly or indirectly by humans. Therefore, methods developed to assess how captive animals are reacting to events around them can be applied to field settings in order to predict responses, mitigate negative impacts, and promote positive outcomes.

3. ALLEY, Maurice

Malaria is now an Emerging Disease in Yellow-eyed Penguins

Authors: Stuart A Hunter and Maurice R Alley

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Abstract: Although *Plasmodium* spp. infection has been known to occur in yellow-eyed penguins (*Megadyptes antipodes*) for more than 70 years, the first clinical case was not seen until 2001 and very few cases have been seen in this species until recently. In the summer of 2015, two yellow-eyed penguins and a Fiordland crested penguin from the Otago coast were found to have died of *Plasmodium elongatum* infection. These birds had a markedly enlarged liver and spleen and a well-developed interstitial pneumonia containing intracytoplasmic protozoa typical of *Plasmodium* spp.. Over the last two years the number of deaths consistent with avian malaria has increased steadily until in the summer of 2018 the disease was diagnosed as the cause of death of more than 25 penguins from the Otago region. The disease has only been seen during the summer when mosquitoes are abundant but both wild and captive, juvenile and adult birds are affected.

4. AO Yuko

Activity Report of Penguin Fund Japan

Authors: Yuko Ao, Noriko Suzuki, Itiyo Ohara, Tomi T. Tsuda, Hayao Izuhara

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Penguin Fund Japan

Abstract: Penguin Fund Japan, founded in 1986, is volunteers' group of penguin lovers in Japan with a motto: "Sharing our future with Penguins" The aims of Penguin Fund are as follows:

- (1) To contribute for the group and individual which protects the penguin, and interact with penguin researcher all over the world.
- (2) To coordinate the sending of volunteers to penguin habitats and reserves,
- (3) To publish books, brochures and other informative materials on penguins.
- (4) To collect literature of penguins and penguin goods.

We have done activity by our very unique and pleasant method more than 30 years.

We hold a meeting to talk about a penguin every two months. The participant bring a penguin goods as entry fee. Those goods are auctioned on the meeting. We donate sales proceeds. This method is very simple, and it is very fun, and everyone can be happy. We have contributed to conservation and research of wild penguins. To know about the penguin deeply we invite researcher, biologist, breeding staff, illustrator, and collector of goods as a lecturer for study session, five times a year. Some of our members visited penguin habitats to observe and investigate wild penguins. We call the tour PENRE (Penguin Research Expedition). Occasionally, we publish new books, translations, brochures and past cards, all of which are related to penguins from many aspects. And, now members are preparing for the realization of big dreams to establish the museum to store one's enormous collections, a book, goods, art, document etc.

5. ARRIAGADA, Maite

ELIGIBLE FOR STUDENT POSTER AWARD

Assessment of touristic impact on agonistic behavior of breeding King penguin (*Aptenodytes patagonicus*) at bahía nútil, Tierra del Fuego

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Abstract: Tourism at wildlife areas represents a great educational opportunity for visitors. However, this activity is developed with the risk of disturbing wild animals. To avoid these alterations, parks and wildlife sanctuaries developed tourism management guidelines. The lack of paucity to conduct studies in the place where these guidelines are applied might cause an extrapolation of management guides that fail to acknowledge specific habitat attributes.

A King penguin colony has been described at bahía Inútil, Tierra del Fuego, Chile. The settlement of the colony motivated the creation of King Penguin Park in 2011. Since then, tourist can visit the colony all year round with a marked increase of visits during summer.

On 2015, from February to March, visual recordings were undertaken to determine the impact of tourism on the agonistic behavior of breeding penguins.

No significant relation was found between territory defense behaviors and the presence of tourists. Although, temperature and aggression had a negative correlation. Therefore, precautions should be taken regarding periods with high temperatures.

This research provides some guidelines to King Penguin Park in order to develop a species- and site specific- guide and management plan. Future studies should consider that tourists might disturb penguins without causing a behavioral response, therefore, there is a need to involve physiological variables. On the other hand, weather variability and tourist behavior should be registered in order to develop more accurate guidelines.

6. BARBOSA, Andrés

Intrinsic factors determining the foraging behaviour of Antarctic penguins

Authors: Andrés Barbosa (1), Roger Colominas (1), Andrea Bueno (1), Josabel Belliure (2), Jesus Benzal (3), Carols De La Cruz (4), Juan F. Masello (5)

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Abstract: Penguins can be considered as central place foragers during breeding going to sea to forage and returning to the breeding colonies every day to feed their chicks. Following the predictions of the optimal foraging theory individuals should optimize the intake rate selecting foraging patches where the net energy gain is maximum and minimizing the foraging costs. Such costs include movement for food searching and capture. In general most of the penguin foraging behaviour studies within the optimal foraging theory have been addressed to explain the effects of extrinsic factors such as prey distribution, competition or predation. However, intrinsic factors which determine trade-offs that affect the energy allocation among different physiological activities such as the immune response have been poorly studied. Moreover, although direct foraging costs in terms of energy are important, indirect costs such as the consequence of the metabolic activity in the oxidative balance of the individuals should also be determined. We study the foraging behaviour of Gentoo and Chinstrap penguins by deploying GPS and TDR (time depth recorder) in two different locations (Byers Peninsula, Livingston island and Deception island, South Shetlands). The variables analysed were maximum distance from the colony, maximum time spent during the foraging trip, mean and maximum foraging speed, dives number, mean and maximum diving depth, mean and maximum time diving, immunoglobulin concentration, reactive oxygen metabolite level and antioxidant capacity. Our preliminary results show the existence of trade-offs between different physiological functions affecting penguin foraging behaviour.

7. BARHAM, Peter

Penguins don't read the textbooks

Authors: Barbara Barham, Peter Barham

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University of Bristol, UK

Abstract: In the course of our work on Robben Island over the past two decades, we have had some truly odd encounters with penguin behaviour that are not normally recorded in research papers or text books. In this presentation we will take a light hearted look at some of these stories including:

- The penguin that would come rushing out of its nest to attack you if you approached within 20m, while its partner would sit quietly and welcome you to its nest.
- The penguins that built their nests in trees.
- Birds that choose to come ashore at the Southern tip of the island and then walk along the coast up to 2km to get to their nest each evening, rather than coming ashore at the regularly used landing site close to their nest.
- The pair of penguins that attacked and killed a 2m Mole Snake.
- Strange 'partnerships' where three penguins raise a single clutch and cases where a single penguin raised two clutches simultaneously with two different partners.
- Birds that have been found to sit on eggs during the day and then only go out to sea to forage in the night time.

While these are all atypical behaviours they serve to remind us no matter what our textbooks tell us we should always remember the penguins don't read them.

8. BARREAU, Emmanuelle

Why fine-scale thermal structure is the key to the foraging success of little penguins?

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Abstract: Phillip Island hosts a mega-colony of little penguins (*Eudyptula minor*), making them good bio-indicator of the marine ecosystem in Bass Strait, Australia. Little penguins forage better, increasing their prey encounter when a thermocline is present in the water column. It seems to act as a barrier for the prey. But they are not always present, tending to get mixed and disappeared under stormy conditions. In parallel, there are marked individual differences in the rate of prey encounter. We hypothesized that daily differences in foraging strategies of individual penguins could reflect water column disturbance in their foraging zone. We thus combined satellite oceanography and little penguin tracking data (n=23 birds) during the chick guard stage in 2018, a season of low reproductive success. We observed short-term water column perturbations during this period and, as predicted, penguins' foraging performances was substantially affected. We found an increase in distance travelled from the colony almost three times the average distance. It was concurrent to a decrease in dive duration, depth, and prey encounter rates when the water column was more mixed. This change was accompanied by a deterioration of the body mass difference between and after a trip. Prey may have become more widely dispersed in the water column making them challenging targets for penguins. Mixed waters regimes are expected to become more frequent due to more stormy days under climate change. Our findings are crucial to predict the foraging success of little penguins accurately under less successful years to support fine-scale planning.

9. BARRIONUEVO, Melina

ELIGIBLE FOR STUDENT POSTER AWARD

Winter dispersion in Magellanic Penguins: differences between sexes and years

Authors: Melina Barrionuevo, Javier Ciancio, Nahuel Marchisio, Antje Steinfurth, Esteban Frere

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Abstract: Magellanic Penguin migration has only recently started to be completely studied. This species is the most migratory of the *Spheniscus* genus and has a major role in balancing the marine ecosystem of the Patagonian shelf, because of its large prey consumption. To study its migration, we have attached 26 geolocators (MK3 & MK4) to adults during two years 2017-2018 in Puerto Deseado, Argentina (47°45'S, 65°53'W). Preliminary analysis of 12 devices revealed that the distance covered by penguins varied between years, being almost double in 2018 compared to 2017 ($x_{2017}=21803$ km, $x_{2018}=45023$ km, $t=3.60$, $p=0.005$). Kernel densities also showed differences in habitat use, being penguins in 2017 more widely distributed along the Argentinean platform than in 2018, specially during May and August. Each individual had a larger path in 2018, but the used area by all penguins was smaller in 2018 than in 2017. Preliminary analysis showed that penguins locations are closely related to SST~10°C and that there were differences in SST between years. There were differences in the longitudinal distribution between sexes: males reached further distances from the coastline ($t=2.01$, $p=0.07$), and were closer to the 200-isobath ($t=-2.43$, $p=0.04$) and more time behind the 200-isobath ($t=-1.98$, $p=0.05$) than females. In 2017, stable isotopes analysis of blood samples when arriving to the colony from migration revealed differences between sexes in C13 showing a possible segregation in the diet. Studying penguin migration during many years is key to help in their conservation and to understand the health of the oceans.

10. BASTO-EYZAGUIRRE, Arianna

Observed philopatry in Humboldt penguin (*Spheniscus humboldti*) cohorts to Punta San Juan, Peru between 2001 and 2015

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Abstract: Philopatry is the return of individuals to their natal colony to breed; a behavior commonly observed in seabirds. The degree of philopatry varies among seabirds and has not been determined in many species. Between 2001 and 2015, we monitored the proportion of breeding returns of banded Humboldt penguin chicks (*Spheniscus humboldti*) to Punta San Juan (PSJ), Peru to estimate philopatry degree. We recorded how often individuals returned to breed, season preference and age of first breeding. In this study, 494 chicks of 13 cohorts were banded in one of the main Humboldt penguin study sites (S4/S5) within PSJ. A total of 52 individuals returned to breed to S4/S5 during the study period. We estimated a mean of 0.08 ± 0.08 in the proportion of breeding returns between cohorts (range: 0.00-0.23). Of the returning individuals, 59.6% (n=52) returned 1-3 breeding seasons in the 16 years of the study. Majority of breeding returns (70%, n=185) occurred during the first breeding season (April-July). Also, we found age at first reproduction was at 3-4 years of age in 65% (n=52) of individuals. We observed high variability between cohorts and breeding seasons, and an increment of >30% in Humboldt penguin abundance between 2001 and 2015 in PSJ. Genetic studies along the Humboldt penguin distribution consider PSJ an important source colony. We consider underestimations in philopatry in this study are due to limited access to record banded individuals at alternative sites within PSJ. Finally, we suggest that philopatry degree of Humboldt penguins is higher than observed.

11. BEAULIEU, Michael

Hearing in penguins: a novel and multidisciplinary project

Authors: Michaël Beaulieu (1), Guido Dehnhardt (2), Jana Hoffmann (3), Tabea Lange (2), Helen Rößler (1), Kenneth Sørensen (4), Magnus Wahlberg (4), Michael Dähne (1)

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Abstract: The Ocean is typically considered as the realm of silence on Earth. Penguins have evolved over millions of years under such silent conditions, and they may have evolved a refined hearing capacity to exploit the acoustic properties of the ocean. Penguins also appear to hear accurately in the air, as despite the loudness of breeding colonies, they are still able to recognize their relatives based on the acoustic properties of their calls. Altogether, this suggests that penguins have evolved a refined hearing capacity both under water and in the air.

In this context, the German Oceanographic Museum in Stralsund (Germany) has recently launched a new research program on the hearing capacity of penguins in cooperation with the University of Rostock (Germany), the Natural History Museum in Berlin (Germany) and the University of Southern Denmark (Denmark). The aim of this project, funded by the German Environment Agency, is to examine the hearing capacity of several penguin species with a special focus on Antarctic species. Towards this end, behavioural and electrophysical methods are being developed under water and in the air for birds maintained in captivity or studied in the wild. Moreover, an inventory of the underwater and terrestrial sounds that penguins experience in Antarctica is being assembled. The ultimate aim of our project is to provide scientists and politicians with data on the hearing capacity of penguins to assess whether their sound environment may represent an additional environmental constraint due to increasing human activities in their natural habitat.

12. BORBOROGLU, Pablo Garcia

Breeding range expansion and population distribution shifts of Magellanic Penguins in northern Patagonia, Argentina

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Abstract: Understanding changes in seabird distribution and abundance is fundamental to effectively direct conservation and management strategies. Magellanic penguins (*Spheniscus magellanicus*) have 66 breeding colonies distributed along 4000 km of coastline in Patagonia, Argentina, with a global population of 1.2-1.6 million pairs. We updated the distribution pattern and estimated colony size and trends at the stronghold of the global population, located along the northernmost Atlantic breeding range. In this 1,000 km sector, we censused 28 colonies that total 628,000 pairs, representing 42% of the extant colonies and 57% of the global population. Colony sizes were highly variable, from 31 breeding pairs in Isla Vernaci Sudoeste (45°S) to 199,140 in Estancia San Lorenzo (42°S). Mean and maximum density (active nests/100m²) were variable among colonies, but the highest values were found in northern Chubut (Estancia San Lorenzo, dmax = 83) and the lowest in golfo San Jorge, southern Chubut (Isla Tovita, dmax = 7). Colony growth rates were variable, but virtually all colonies located in the northernmost area (Rio Negro and northern Chubut) continued showing consistently high rates, while in central and southern Chubut colonies declined or remained relatively stable. Estancia San Lorenzo became the largest colony known for the species, exceeding Punta Tombo (42°) by approximately 60,000 pairs. Recently, new colonies expanded the species breeding distribution range; Punta Pozos (41°S) in 2014 and Bahía San Antonio (40°S) in 2018. The northward redistribution of the metapopulation is generating new conservation and management challenges, particularly related to tourism development.

13. BORBOROGLU, Pablo Garcia

Penguins and MPAs in Argentina, what's next?

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Abstract: The Argentine Sea has 1,500,000 km² and 5,800 km of coastline. Three decades ago, the marine area protected was lower than 0.3%, restricted to small coastal sites. The protected area (PA) is now 8%, mainly due to the recent creation of 3 large Marine National Parks (MNP). The UN's Conventions on Biological Diversity goal is to protect 10% of the marine surface by 2020. Argentina now has 63 coastal-marine PAs, of which only 25 include some small marine component and 3 are exclusively oceanic. Ten PAs benefit penguin breeding or foraging areas. GPS worked with government to designate a Biosphere Reserve of 8 million acres including 25 colonies and the MPA at Punta Tombo. GPS has also designed management plans for 18 penguin colonies and assisted decision makers in their implementation. GPS's joint efforts with other NGOs and the government catalysed the creation of the first three large MNP, promoted legislation that created an MPA system, helped identify key areas, and continued working until their designation. GPS is working with other NGO's on proposals for new MNPs that extend protection in national waters during penguin foraging and migration trips. We discuss the political, social and economic challenges in this developing country and discuss if current protection fits conservation needs. Penguins are iconic animals in public perception. GPS contributed to showcase how penguins benefit from MPAs in the argentine policy making process. We helped galvanizing policy makers positive perception on this conservation tool, an experience that could be explored in other countries.

14. BRANSOME, Nicole

A review of the impacts of climate change and fishing on penguin populations in the Western Antarctic Peninsula region

Authors: Nicole Bransome (1), Annika Cobb (2), Cassandra Brooks (2)

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Abstract: Penguins are key mesopredators in the Antarctic marine ecosystem. Yet, some populations of penguins (Adélie, *Pygoscelis adeliae*; chinstrap; *Pygoscelis antarctica*) in the Western Antarctic Peninsula (WAP) region are in decline. The WAP is one of the most rapidly changing environments on Earth, with changing precipitation patterns and a reduction in sea ice extent and duration. Scientists have linked these environmental changes to shifts in the WAP ecosystem, including potential declines in krill, shifts in algal communities and potential declines in Adélie and chinstrap penguin populations. Declines in penguin populations are often due to alterations in availability of quality prey, nesting habitat, and juvenile fitness and recruitment. While climate change threats are widely acknowledged, there is less agreement on precisely which factors drive penguin population trends nor the best way to ameliorate these changes. While penguins strive to adapt to environmental changes, the fishery for Antarctic krill (*Euphausia superba*) has been expanding in recent years, concentrating in coastal areas off the WAP. Managers, scientists and the conservation community are all concerned that this additional draw on local krill can negatively impact already-fragile penguin populations. Here, we present a review of climate change around the WAP, with an emphasis on how climate change is impacting krill and krill-depend penguin species, as well as the cumulative impacts of krill fishing and climate effects on the region's penguins. Finally, we close with an examination of management measures that may provide for precautionary management of the WAP, including fishery buffer zones and marine protected areas.

15. BRIBIESCA-CONTRERAS, Fernanda

ELIGIBLE FOR STUDENT POSTER AWARD

3D imaging techniques to study underwater locomotion in the Humboldt penguin (*Spheniscus humboldti*)

Authors: Fernanda Bribiesca-Contreras, Ben Parslew, William Sellers

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University of Manchester, UK

Abstract: Animal locomotion outside the laboratory is commonly studied using video recording to describe and quantify movement dynamics. However, video-based approaches are limited to a two-dimensional axis that often leads to missing information due to the inherent 3D nature of motion. In this study, we applied markerless 3D photogrammetry to study diving in the Humboldt penguin (*Spheniscus humboldti*) and computed-tomography (CT) to produce high-definition 3D models of body shape at different stages of the wingstroke cycle. Markerless 3D photogrammetry is a novel approach that provides both a temporal and spatial resolution of locomotion and works with completely undisturbed and unmarked animals. It has the advantage of being self-calibrating based on the separation between the cameras, allowing absolute quantification of movement. Humboldt penguins were recorded swimming at Chester Zoo using four synchronised video cameras, then individual frames were extracted and used to generate 3D reconstructions of a range of swimming modes. CT images of a Humboldt penguin were used to produce a mesh model of the full body. Using Blender we built an internal 'skeleton' and bound it to the body model. When the skeletal elements are moved, the mesh deforms around it resembling a realistic geometry. This way, we can pose the penguin model in any diving position. The combination of these techniques allowed us to quantify swimming kinematics and produce static and animated surface geometries that can be used for computer fluid dynamics analysis that will provide insights into the biomechanics of diving in penguins.

16. CARPENTER-KLING, Tegan

ELIGIBLE FOR STUDENT POSTER AWARD

Fine scale $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ isoscapes around the Prince Edward Archipelago, Southern Indian Ocean, using penguin blood

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Abstract: The carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) isotopic composition of marine predators' tissues has increasingly been used for their retrospective geolocation. These values have been shown to be reflected in predator's tissue isotopic composition but with a stepwise trophic enrichment ($\delta^{13}\text{C}$: 0-2 ‰ and $\delta^{15}\text{N}$: 2-5 ‰ per trophic level). Clear gradients of $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ at the base of marine food webs have been defined across the global oceans as well as from neritic to oceanic waters. Accurate retrospective geolocation of marine predators via their isotopic composition requires high-quality maps of these gradients ("isoscapes"), highlighting the importance of establishing species- and area-specific isoscapes. Here, we present fine scale isoscapes around the Prince Edward Archipelago, Southern Indian Ocean, by integrating foraging tracks of four penguin species (king *Aptenodytes patagonicus*, gentoo *Pygoscelis papua*, macaroni *Eudyptes chrysolophus* and rockhopper *E. [chrysolophus] filholi* penguins) with the $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values of their blood plasma. As the foraging ranges of these penguins vary greatly, from gentoo penguins, which forage over the shelf of the archipelago (~15 km from colony), to king penguins, which forage in pelagic waters at the Antarctic Polar Front (~500 km south of the archipelago), the resulting isoscapes reflect neritic to oceanic as well as latitudinal $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ gradients. These isoscapes can be used to increase the precision of future retrospective geolocation of the penguins breeding at the archipelago using the isotopic composition of their tissues.

17. CHEREL, Yves

Penguins as relevant biomonitors of temporal and spatial trends of mercury in the Southern Hemisphere

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Abstract: Marine ecosystems are impacted at the global scale by Hg, and the combined effects of climate change and human activities could lead to a dramatic increase of its bioaccumulation in marine organisms in the future. Indeed, the general warming of ocean water masses is affecting the cycle of Hg, thereby increasing exposure of marine organisms. Therefore, monitoring Hg at large scales, both spatially and temporally, is essential to better apprehend the impacts of anthropogenic activities and climate change on bioaccumulation of Hg in marine organisms. We propose to use penguins as bioindicators of the environmental contamination by Hg in the Southern Hemisphere. Penguins are relevant seabirds to monitor Hg as: 1) they reflect the contamination of the food web on which they rely on; 2) they have a wide distribution and different species occupy various ecological niches; 3) they are colonial and philopatric, giving the opportunity to sample several individuals simultaneously and to monitor them repeatedly through time since non-lethal sampling of blood (short-time exposure) and feathers (long-term exposure) is easy on penguins; 4) feathers can be collected from Museum specimens, allowing retrospective investigation of Hg time trends. Penguins therefore appear to be ideal organisms to: (1) monitor spatial variations of Hg in marine ecosystems at different latitudes; (2) define hotspots of Hg contamination in the different large ecosystems and highlight sensitive areas that require particular attention and protection; (3) carry long-term monitoring of Hg trends in the different parts of the World Ocean. An effort is now needed to strengthen the existing sampling networks from the different geographical areas in the Southern hemisphere and to bring together scientists on this important topic.

18. CHIARADIA, Andre

Higher foraging efficiency in well vertically-stratified water columns in the feeding zones of little penguins *Eudyptula minor*

Authors: Victoria Florence Sperring (1,2), Richard Reina (2) Andre Chiaradia (1,2)

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(2) School of Biological Sciences, Monash University, Clayton, Australia

Abstract: Temperature changes in the water column trigger significant life-history events of many marine species. Revealing the ecological responses to temperature changes is fundamental to understand species' capacities to respond to environmental variability. Here we examined whether ocean temperature stratification affects foraging trip duration, body mass change and meal size during breeding stages of the little penguin, *Eudyptula minor*, Phillip Island, Australia. Foraging duration, meal size and body mass changes were recorded continuously using an automated penguin monitoring system. We obtained Copernicus satellite data for daily sea surface temperature (°C) and the temperature difference between the sea surface and 55 m depth (delta temperature) used as a proxy for water stratification. Penguins made significantly shorter foraging trips under greater water stratification during the high energy demand stage of the post-guard reproductive stage but not during the incubation or guard stages. The meal mass was lower under poor water stratification at guard and post-guard stages but did not affect body mass, as adults buffered their body mass changes via short and long foraging trips. These results demonstrate that little penguins alter foraging strategies in response to environmental variability. High stratification of the water column is vital for increasing the foraging success of these penguins, which may be the case for many marine animals.

19. CHIARADIA, Andre

Divide and conquer? Benefits and costs of spatial segregation within a colony of Little penguins

Authors: Jessica Pulvirenti (1), Richard Reina (1), Andre Chiaradia (2)

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(2) Conservation Department, Phillip Island Nature Parks, Victoria, Australia

Abstract: Central place foraging leads to competition for food and space, particularly within large penguin colonies. Spatial segregation is one of the mechanisms to deal with this colonial life constraint. While spatial segregation is well studied between colonies, this process is less investigated at a smaller scale, within a colony. Using the Little Penguin from a megacolony at Phillip Island, Australia, we examined how foraging and breeding success differs between sub-colonies and how environmental conditions may be influencing these differences. Using data from an automated penguin monitoring system and regular nest checks at two sub-colonies, we determined foraging trip duration, body mass change per foraging trip, mean egg-laying date and breeding success, as well as satellite data for sea surface temperature in the foraging areas of each sub-colony. We revealed that foraging trip duration and body mass were different between sub-colonies in most breeding stages. We also found that warmer sea surface temperature was associated with earlier mean laying dates and a lower breeding success between sub-colonies. Our findings show that spatial segregation is strong at small scale and even between sub-colonies. Revealing how spatial segregation occurs at a small fine scale is imperative to understand fluctuations in the marine environment that are fast changing the foraging conditions of the little penguin species.

20. CHRISTIANSON, Anne

The Application of Important Bird and Biodiversity Areas in multilateral policy discussions: the development of Marine Protected Area proposals in the Southern Ocean

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Abstract: The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) was created in 1982 to protect the biodiversity of the Southern Ocean. CCAMLR meets annually to make management decisions based on consensus and using the best available science. In 2011 CCAMLR became the first international body to commit to creating a network of marine protected areas (MPAs), and in 2016 all 24 CCAMLR member nations and the European Union designated the Ross Sea MPA, the largest MPA in the world.

Identification of Important Bird and Biodiversity Areas (IBAs) can be a critical part of natural resource decision-making processes. Recently, scientists from BirdLife International developed a new method to identify marine IBAs (mIBAs); by using habitat models and adapting methods used for flying seabirds, they identified mIBAs for chinstrap, Adélie, and Gentoo penguin populations in the Southern Ocean. Their results, as well as terrestrial IBA data, were considered during the development of the Antarctic Peninsula MPA proposal, introduced to the CCAMLR Scientific Committee in 2018.

Through reviewing how BirdLife International's research was developed and integrated into the CCAMLR Scientific Committee process, we explore how IBAs can be used to inform marine ecosystem management and policy in the Southern Ocean and guide the development of new MPA proposals. As the global conservation community works to protect 30 percent of the oceans by 2030, we examine how researchers can use their data to inform other institutions working towards expanding the global network of marine protected areas.

21. CIRIANI, Yanina

ELIGIBLE FOR STUDENT POSTER AWARD

Stable Isotope Analysis of Multiple Tissues from Pygoscelid Penguin Chick Carcasses for Dietary Studies; Which tissue is best for opportunistic sampling at penguin colonies?

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Abstract: Tissues obtained from penguin carcasses are increasingly being used for isotopic analysis of diet. This method is known as “opportunistic sampling” since chick carcasses are commonly found around active colonies and can be easily sampled without disturbing actively nesting penguins. However, depending on the type of tissue sampled, there could be more variable results and different amounts of fractionation compared to other tissues. Here, we investigated variation and fractionation in stable isotopes ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) among four tissue types collected from chick carcasses of three *pygoscelid* penguin species at 25 de Mayo/King George Island, South Shetland Islands, Antarctic Peninsula, in austral summer 2017-2018. We accounted for annual and geographic variation in isotope values by limiting our collection to one region (Potter and Barton Peninsulas) and one season. We sampled 20-30 carcasses each at active colonies of Adélie (*Pygoscelis adeliae*) and Gentoo (*P. papua*) penguins at Stranger Point, and from Chinstrap penguins (*P. antarctica*) at Barton Peninsula in February 2018. The four tissues (feather, skin, toenail, and bone) are all used in dietary analyses of seabirds, but until now there has been no study on how these tissues vary in isotopic results. We also compared our data to expected diet of the three species as determined from 20 years of monitored stomach contents at Potter Peninsula and more limited sampling at Barton Peninsula. Our results provide for more informed opportunistic sampling to accurately estimate and compare penguin diet among species and colonies.

22. COLE, Theresa

ELIGIBLE FOR STUDENT POSTER AWARD

Mitogenomes uncover extinct penguin taxa and reveal island formation as a key driver of speciation

Authors: Theresa L. Cole (1,2), Daniel T. Ksepka (3), Kieren J. Mitchell (4), Alan J. D. Tennyson (5), Daniel B. Thomas (6), Hailin Pan (7,8,9), Guojie Zhang (7,8,9), Nicolas J. Rawlence (1), Jamie R. Wood (2), Pere Bover (10), Juan L. Bouzat (11), Alan Cooper (4), Steven Fiddaman (12), Tom Hart (12), Gary Miller (13,14), Peter G. Ryan (15), Lara D. Shepherd (5), Janet M. Wilmshurst (16), Jonathan M. Waters (1)

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- (14) University of Tasmania, Australia
- (15) FitzPatrick Institute of African Ornithology, University of Cape Town, South Africa
- (16) School of Environment, University of Auckland, New Zealand

Abstract: The emergence of islands has been linked to spectacular radiations of diverse organisms. Although penguins spend much of their lives at sea, they rely on land for nesting, and a high proportion of extant species are endemic to geologically-young islands. Islands may thus have been crucial to the evolutionary diversification of penguins. We test this hypothesis using a fossil-calibrated phylogeny of mitochondrial genomes from all extant and recently extinct penguin taxa. Our temporal analysis demonstrates that numerous recent island-endemic penguin taxa diverged following the formation of their islands during the Plio-Pleistocene, including the Galápagos (Galápagos Islands), northern rockhopper (Gough Island), erect-crested (Antipodes Islands), Snares crested (Snares) and royal (Macquarie Island) penguins. Our analysis also reveals two new recently extinct island-endemic penguin taxa from New Zealand's Chatham Islands: *Eudyptes warhami* sp. nov. and a dwarf subspecies of yellow-eyed penguin. *Eudyptes warhami* diverged from the Antipodes Islands erect-crested penguin between 1.1 Ma and 2.5 Ma, shortly after the emergence of the Chatham Islands (~3 Ma). This new finding of recently-evolved taxa on this young archipelago provides further evidence that the radiation of penguins over the last 5 Ma has been linked to island emergence. Mitogenomic analyses of all penguin species, and the discovery of two new extinct penguin taxa, highlight the importance of island formation in the diversification of penguins, as well as the extent to which anthropogenic extinctions have affected island-endemic taxa across the Southern Hemisphere's isolated archipelagos.

23. COLOMBELLI-NEGREL, Diane

Behavioural and heart rate responses to stressors in little penguins

Authors: Diane Colombelli-Negrel

Author Affiliation:

Flinders University, Adelaide, Australia

Abstract: Species that are constantly exposed to disturbances, such as non-lethal contacts with predators or conspecifics, can experience chronic stress. Yet, individuals often respond to disturbance differently, maybe due to difference in personalities, early life conditions or prior experiences with stressors. This study investigated how little penguins (*Eudyptula minor*) in South Australia varied in their behavioural and physiological (heart rate) responses to different stressors (cat, dog, human and conspecific). Preliminary analyses showed that little penguins responded with more vigilance to dogs. Individuals that were particularly vigilant were also particularly physiologically responsive. These results align with a growing body of studies showing that individuals vary in how they respond to challenging environments.

24. CROFTS, Sarah

Population status and insights from long-term monitoring of Gentoo and Southern Rockhopper penguins at the Falkland Islands

Authors: Sarah Crofts, Andrew Stanworth

Author Affiliation:

Falklands Conservation, Falkland Islands

Abstract: In the austral summer of 1985-86 a mass mortality involving thousands of southern rockhopper penguins occurred at the Falkland Islands. The resulting investigations concluded the cause was starvation during the moult period, it was hypothesised that shortages of food was attributed to the El Niño phenomena. In 1989 the Falkland Islands Seabird Monitoring Programme was established by Falklands Conservation.

Thirty years later during the austral summer of 2015-16 a second starvation event for southern rockhopper penguins occurred during the moult at the Falklands, and also along the Patagonian coast. A “super” El Niño event took place during this period. Subsequent monitoring in 2016-17 detected notable decreases in breeding pair numbers of gentoo penguin (35 % decrease) and southern rockhopper penguin (31 % decrease) (also black-browed albatross at 31 %), as well as disruptions to reproductive efforts at nearly all the annual monitored sites.

We report on the insights into the population dynamics and species resilience following the 2015-16 environmental disturbances. During the seasons of 2017-18 and 2018-19, the monitoring indicated a higher resilience in the gentoo penguin with a partial recovery in breeding pair numbers. The situation for the globally vulnerable southern rockhopper penguin, on the other hand, showed less resilience with little evidence of population recoveries, and suggests that a level of mortality, possibly involving thousands of individuals, occurred during the moult in 2016. The southern rockhopper penguin continues to be a species of high concern at the Falkland Islands.

25. DARNELL, Geneve

Effectiveness of a screen enclosure at reducing the risk of arbovirus transmission to captive penguins

Authors: Geneve Darnell, Caroling A. Efstathion, Mike Taylor and Nathan Burkett-Cadena

Author Affiliation:

The Jacksonville Zoo and Gardens, USA

Abstract: Reducing the risk of avian malaria, a mosquito-borne protozoan disease, for penguins at zoos, aquariums and rehabilitation centers is a critical component of penguin health. The two broad strategies used to protect captive penguins from mosquitoes are to (1) reduce exposure to vector mosquitoes and/or (2) pharmaceutical prophylaxis. Reducing exposure includes bringing penguins inside night houses during peak mosquito times (dusk to dawn), as well as using door sweeps and screens to exclude mosquitoes. Physical barriers, such as screen enclosures, can be used to enclose entire outdoor penguin exhibits, thereby excluding mosquitoes. Such an enclosure was built at the Jacksonville Zoo and Gardens and our aim was to determine if this screen enclosure is effective at excluding mosquitoes from the penguin exhibit and thereby reducing the risk for transmission of avian malaria and other arboviruses to penguins. We placed multiple types of mosquito traps, both inside and outside of the screened enclosure, overnight weekly from September to October in 2017. Additionally, we placed traps inside the penguin night house. With three trap types over a combined 25 trap nights, only one mosquito was captured inside the screen exhibit. With the same three trap types over the same number of trap nights, we captured a total of 2,171 mosquitoes outside the screen exhibit. No mosquitoes were captured over six trap nights inside the penguin night house. We demonstrated that even with high mosquito pressure outside, the screen enclosure was an effective barrier for excluding mosquitoes. The use of a screen enclosure reduces the risk of arboviral transmission to penguins as part of an integrated mosquito management plan. Screen enclosures should be considered for any institution that houses susceptible penguins outdoors.

26. DARNELL, Geneve

Retrofitting existing exhibits in an AZA Accredited Zoological Facility

Authors: Geneve Darnell, DeeAnna Murphy, Rudy Jara

Author Affiliation:

The Jacksonville Zoo and Gardens, USA

Abstract: It is no surprise that the popularity of the temperate penguins has skyrocketed in the last decade in Zoological Institutions. The continued growth and appeal in penguins is evident in both the staying power of public interest and the growing conservation needs of temperate penguins. However, the cost of building a new exhibit in these tough economic times makes it challenging. This poster visually explains how the Jacksonville Zoo and Gardens retrofitted an existing North American river otter exhibit for Magellanic penguins which had distinct advantages over new construction. Included in the retrofit were changes to the physical features of the exhibit and modifications of the holding area to better suit the environmental needs of the birds. Also, due to the prevalence of mosquito borne illness in Florida, additional features and protocols had been incorporated. The results were an exhibit that is priceless.

27. DARNELL, Geneve

Building Ties between AZA institutions & local wildlife rehabilitation centers

Authors: Geneve Darnell, Holly Smith

Author Affiliation:

The Jacksonville Zoo and Gardens, USA

Abstract: Institution conservation is a major part of the Association of Zoos & Aquariums mission to promote conservation of the World's wildlife. An underutilized tool in this mission is the local wildlife rehabilitation centers and sanctuaries. Many AZA institutions provide financial support to rehab facilities both in foreign countries and in the US. In exchange these rehabilitation facilities often provide non-releasable animals to the AZA institution. Although unable to survive in the wild many of these animals can be valuable as ambassadors for educating the public as well as helping to repopulate declining species. Although Zoos and Aquariums provide financial support, supplies, and training to rehabilitation centers is often rudimentary. The Suncoast Seabird Sanctuary is the one of the largest seabird sanctuaries in North America, this is an example of how a cooperative relationship can benefit both institutions. The sanctuary has provided birds to AZA accredited institutions as well as facilities in Europe and Asia. The resources provided by the Sanctuary go beyond the the availability of animals. Information has been provided on nutrition, breeding behavior, population trends and is a source of conservation education for the public. By supporting local rehabilitation efforts directly affects the conservation of North American birds.

28. DARNELL, Geneve

Penguin and skeeters..... a toxic combination

Authors: Gen Darnell, Caroline Efstathion, Karen Meyer, Nathan Burkett-Cadena

Author Affiliation:

The Jacksonville Zoo and Gardens, USA

Abstract: Amidst the sixth mass extinction our planet is experiencing due to anthropogenic factors, inspiring the next generation of conservation scientists is imperative to save the planet's biodiversity. Exposure to real world problems and actual scientific data sets can demonstrate the importance of conservation to young adults. This can be achieved by bringing real-world data into the classroom. Classroom activities, based on actual datasets collected from conservation scientists, does this. We have written a classroom activity that asks students to develop an integrated mosquito management plan for captive penguins that will reduce their risk of getting avian malaria. This activity is based on actual data that has been collected at a zoological facility. Students must use a data set to construct graphs and answer critical thinking questions. This activity allows students to get a sense of what science is about and learn the problems that wild and captive penguins are experiencing. This activity can be adapted for any grade level and is a great activity for summer programs and education outreach.

29. DAVIS, Tanith

Oliver the King Penguin (Aptenodytes patagonicus)

Authors: Tanith Davis, Sarina Walsh

Author Affiliation:

SeaLife Melbourne Aquarium, Australia

Abstract: Oliver is a King penguin at SeaLife Melbourne Aquarium. He survived many major issues both as an embryo inside an egg and as a young chick. The penguin team worked tirelessly to ensure this chick not only hatched, but also thrived. Oliver survived rejection as an embryo inside the egg, artificial incubation, assist hatching, being fostered to a single male, rejection as a chick, tube feeding for 14 days, fostering from another pair, and finally returned to the original foster parent. Although it was a drawn out and highly stressful situation, much was learned and gained from this experience for all involved. These are important lessons for anyone working with captive breeding penguins.

30. DE BLOCQ, Andrew

Tracking African penguins in their sensitive pre- and post-moult life stages: conservation implications for a species threatened by a lack of food

Authors: Andrew de Blocq (1), Taryn Morris (1), Jennifer Roberts (2), Craig Harding (2), Alistair McInnes (3), Christina Hagen (1), Lorien Pichegru (2,3), Ross Wanless (1,2), Peter Ryan (2)

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Abstract: African penguins *Spheniscus demersus* have suffered a drastic decline over the last 100 years, and were uplisted to Endangered in 2010 following the population halving since 2000. The major current threat to the species is a lack of food, especially during sensitive life stages such as breeding and moulting. While breeding birds have been relatively well studied, little is known about their non-breeding movements. The moulting period is particularly stressful as the birds are land-bound and endure a 3-4 week fast. Sufficient food before (pre-moult fattening) and after moulting (post-moult recovery) is therefore crucial. Mortality during these sensitive windows is suspected to be an underestimated contributor to the ongoing decline in this species.

BirdLife South Africa has led a study since 2012 tracking adult African penguins during these pre- and post-moult periods. Knowledge of their movements is key to ensuring that important areas and habitats are protected from competition with fisheries. We report the pre- and post-moult movement ecology of adults from three important breeding sites in the Western and Eastern Cape of South Africa. Birds from Western Cape colonies tend to travel further and spend longer at sea than birds in the Eastern Cape where birds forage in shorter bouts and regularly return to the colony. These results have conservation implications for the species during these sensitive periods, with spatial management of fishing quotas and designation of protected areas being two potential options.

31. DELL'ARICCIA, Gaia

Little penguins are attracted by the smell of food but not by the smell of their nest

Authors: Gaia Dell'Ariccia (1,2), Francesco Bonadonna (2), Ross Holmberg (1), & André Chiaradia (1)

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(1) Conservation Department, Phillip Island Nature Parks, Victoria, Australia

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Abstract: Procellariiformes use the sense of smell to orient, navigate and find food in the middle of the ocean. On land, olfaction has been used by these seabirds as key cue for homing at night in burrow-nesting species. Penguins are phylogenetically closely related to Procellariiformes but their use of odours for foraging is poorly known. In addition, whether penguins use olfaction for homing has never been investigated, despite some penguin species are burrow nesting like many petrels. Here, we investigated the sensory ecology of Little penguins (*Eudyptula minor*), the only burrow nesting penguin species which is exclusively nocturnal at the colony. We performed Y-maze choice tests to investigate whether breeding adult penguins are able to a) detect DMS, a food related odour, and b) distinguish between their own and another random nest by the odour. Our results show that adult Little penguins detected and were attracted by DMS. Inversely, when they were given the choice between their nest odour and the odour of another neighbour nest, they showed no behavioural preference. Our results suggest that Little penguins may use olfactory cues to locate productive areas at sea. However, our results do not support the use of olfaction when homing to the nest burrow. It is possible that adult Little penguins prefer more constant and reliable cues such as topographical features to locate the burrow. We highlight that understanding how sensory ecology is shaped can bring another dimension to benefit the implementation of conservation plans and provide new insight for new solutions.

32. DEWAR, Meagan

Microbial ecology of natural and artificial penguin burrows: implications for reproductive success, penguin health and conservation management

Authors: Meagan Dewar (1, 2), Eric Woehler (3), Peter Dann (4)

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(3) Marine and Antarctic Futures Centre, Institute for Marine and Antarctic Studies, University of Tasmania

(4) Phillip Island Nature Parks, Australia

Abstract: The provision of artificial breeding sites has been used very successfully around the world as a practical means of managing populations limited by breeding site availability. Over 1000 nest-boxes have been installed on Phillip Island for penguins and up to 90% of the boxes are used for breeding, shelter and moulting. Nest-boxes, persist as breeding sites much longer than most natural sites, sometimes for decades, are excavated less frequently and accumulate significant amounts of excreta. Therefore nest-boxes may harbour a different suite of microbial species than natural burrows with potential implications for penguin health. In addition, soil type may influence the microbial community of a nesting site. This raises the questions, is the microbial community in boxes similar to that in natural burrows? And are birds nesting in boxes at greater risk of disease? This study compared the microbial composition of natural and nest boxes on different soil types to answer these questions.

The results from this study have shown that the microbial community (composition and diversity) of penguin burrows differs significantly with time (pre and post-breeding), nest type (natural vs artificial) and soil type (sand vs clay), indicating that artificial burrows, soil composition and penguin attendance influence the microbial composition. However, despite having different microbial communities, nest-boxes had a better breeding success in comparison to natural burrows, reinforcing an earlier study and gives us confidence to continue using nest-boxes to increase the availability of nest sites and enhance penguin adaptation to climate change.

33. DIAS, Maria

Threats to penguins: A global assessment

Authors: Maria P. Dias (1), Rob Martin (1), Elizabeth J. Pearmain (1), Ian J. Burfield (1), Cleo Small (2), Jonathan M. Handley (1), John Croxall (1,2)

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Abstract: Penguins are widely regarded as sentinels of the marine environment. However, a number of species have seen rapid population declines in recent years. It is imperative to identify the threats to these species in order to determine effective conservation actions. Through a global literature review of threats to seabirds, we present the first objective quantitative assessment of the threats to all 18 species of penguins, reviewing data and publications up to 2018, and outlining priority actions and challenges. We applied the standardised International Union for Conservation of Nature (IUCN) Red List Threats Classification Scheme and associated scoring system to each threat affecting penguin species. The top five of seventeen threats to penguins (in terms of number of species affected and average impact) were: 1) climate change and severe weather; 2) overfishing; 3) bycatch; 4) disturbance at the colonies; and 5) invasive alien species. Furthermore, half of all penguin species are affected by both marine and terrestrial threats. This emphasises the need for “ridge to reef” conservation solutions whereby management plans should aim to protect species from threats both on land and at sea. Importantly, while some species had comparatively fewer threats, the average impact of these threats was much higher. There is therefore a need for urgent conservation interventions to mitigate biodiversity loss. As the negative effects of climate change are hard to mitigate for individual species, it is vital to compensate by addressing these top threats, for which proven solutions exist in most cases, although many implementation challenges remain.

34. DODINO, Samanta

ELIGIBLE FOR STUDENT POSTER AWARD

Winter dispersal of Magellanic penguins at Martillo Island: Sexual differences in movement patterns and trophic ecology

Authors: S. Dodino (1), L. Riccialdelli (1), M. Polito (2), K. Pütz (3), A. Raya Rey (1,4,5)

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Abstract: The dispersal of penguins during the non-breeding period is a critical period that can affect breeding success and survival in the following season. Thus, knowledge of penguin foraging ecology during this energy-intensive period is crucial to understand their responses to ecosystem variability. We recorded winter dispersal of Magellanic penguins *Spheniscus magellanicus* from Martillo Island (Beagle Channel, Argentina) using LAT2900 geolocators in 2017. We collected whole blood samples when the penguins first arrived at the colony in spring to study their pre-breeding foraging niche using stable carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) isotope analysis. In total, 26 adults were equipped after their annual molt, of which 24 were re-captured. However, only 20 were still equipped with devices and only 9 datasets could be recovered successfully. We found that penguins dispersed north along the Patagonian coast up to just south of Buenos Aires, Argentina ($<38^\circ\text{S}$). In addition, prior to their return to the breeding site (August-September), females were mainly concentrated in more southern waters (between 49°S to 55°S) relative to males (between 41°S to 45°S). We also observed a significant difference between sexes in $\delta^{13}\text{C}$ ($W=25$, $p<0.05$) but not in $\delta^{15}\text{N}$ values ($W=53$, $p>0.05$), with females also having larger isotopic foraging niche widths (SEAb) relative to males. Differences in the spatial distribution and isotopic values between sexes likely reflect a pattern of niche partitioning during the non-breeding period. These results provide insights into mechanisms that may reduce intraspecific competition and can possibly inform sex-specific conservation strategies during the non-breeding period.

35. DRISCOLL, Maureen

Fecal Glucocorticoid Metabolite (FGM) Analysis as a Noninvasive Method to Monitor Health in the Endangered African Penguin

Authors: Maureen Driscoll, Allison Tuttle, Tracy Romano

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Mystic Aquarium, Mystic Connecticut, USA

Abstract: African penguins are an endangered species with less than 22,000 breeding pairs left in the wild. Despite conservation efforts, populations continue to decline rapidly as a result of environmental and anthropogenic stressors, such as disruption of nesting sites, oil spillages, and shifts in prey availability and distribution. In vertebrates, glucocorticoids are released by the adrenal cortex as part of the stress response, which is both beneficial and necessary for survival. However, chronic release of these hormones can result in compromised immune function, cognitive skills, reproduction, and survival. Fecal glucocorticoid metabolites (FGM) are a valuable source of endocrine information and provide a noninvasive alternative to blood to monitor hormone levels in wildlife populations. Furthermore, while blood sampling reflects activity at the time of sampling, FGM reflect chronic levels, with multiple hours of hormone accumulation in each sample. In this study, we validated a commercially available corticosterone enzyme immunoassay (EIA) for measuring FGM in African penguin feces by passing tests for parallelism, accuracy, and inter- and intra-assay variability. We also carried out a biological validation with African penguins housed at Mystic Aquarium to show that FGM levels increase in response to an external challenge. Samples collected from aquarium penguins show that females exhibit a significant increase in FGM levels during the beginning of breeding season, demonstrating that this method is capable of measuring physiologically meaningful changes. FGM analysis is a promising tool to monitor wild African penguin colonies undergoing different pressures, thus has potential to play a key role in conservation strategies.

36. DYER, Bruce

Diet of Eudyptes penguins at Marion Island, southwest Indian Ocean, 1994–2018

Authors: B.M. Dyer, A.B. Makhado, L. Visagie, R.J.M. Crawford, M. Masotla

Author Affiliation:

Department of Environmental Affairs, Biodiversity & Coastal Research, Cape Town, South Africa

Abstract: The diet of Macaroni and Southern Rockhopper Penguins at Marion Island (Southern Ocean) was monitored during their breeding seasons for 25 years from 1994 to 2018 using a water offloading technique. Crustaceans and squids in diet samples were mostly whole and easily weighed. By contrast, the fish component was well digested and consequently its wet weight was substantially under-estimated. Therefore, fish otoliths were collected and identified. When available, relationships between otolith length and fish length and between fish length and fish weight were used to estimate the mass of fish in the diet. This allowed the mass of the fish component of the diet to be reconstructed. On average, crustaceans contributed 57% by mass of the diet of Macaroni Penguins, fish 41% and squids 2%. For Southern Rockhopper Penguins, crustaceans on average contributed 82% by mass, fish 16% and squids 2%.

37. ELSOM, Henry

ELIGIBLE FOR STUDENT POSTER AWARD

Inter-colony variation in foraging behaviour of little penguins (*Eudyptula minor*)

Authors: Henry Elsom (1), John F. Cockrem (1), Philippa Agnew (2)

Author Affiliation:

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(2) Oamaru Blue Penguin Colony, Waterfront Road, Oamaru, New Zealand

Abstract: Little penguins in Oamaru are primarily distributed between two distinct colonies located 1km apart. The 'Quarry' colony is run as an ecotourism operation, whilst the Oamaru Creek Penguin Refuge is closed from public access. Despite the colonies' proximity, penguins typically return to the colony from which they fledged. Furthermore, each colony has comparable survivorship and breeding success and population growth rates are similar. However, little is known about the foraging behaviour of creek colony birds. Hence, we investigated and compared the foraging behaviour of birds from each colony. 25 birds were tracked using data loggers, with 54 foraging tracks recorded. Results suggest that there may be differences between colonies in penguin foraging behaviour. Creek birds foraged at a greater maximum range from the colony and may forage over a larger area compared with Quarry birds. In addition, we demonstrated that the home range of birds from each colony overlapped to some extent, and also identified key foraging areas and bathymetric preferences. Differences between colonies in foraging behaviour does not appear to influence breeding success and survivorship of little penguins in Oamaru. Future study, however, should assess foraging behaviour at multiple breeding stages, and during times of reduced resource availability.

38. GARLAND, Chloe Olivia

Education and Wildlife Tourism: An investigation into the visitors learning experience at Stony Point's African Penguin Colony, Cape Town, South Africa

Authors: Chloe Olivia Garland

Author Affiliation:

The University of Exeter, UK

Abstract: African penguins (*Spheniscus demersus*) are listed on the IUCN Red list as 'Endangered' (IUCN, 2018; DEA, 2013) and the remaining 2.5% of the population are still in a continued decline (DEA, 2013). It is currently estimated that only 21,000 breeding pairs are left in the wild (IUCN, 2018). This is in stark contrast to the 1.5 million breeding pairs that were present during the 1920's, when they were the largest seabird population in South Africa (DEA, 2013).

African penguins are one of South Africa's charismatic species that attract people from all over the world (Lewis et al, 2012). Education during tourism is often considered to be a key benefit towards conservation as it increases the visitor's awareness of environmental issues and results in pro-conservation attitudes and behaviours post visit as well as increases the financial support towards conserving the species (Higginbottom, 2001:1).

However, education is often based on the premise that providing information is enough to educate (Ballantyne et al, 2007). I undertook an initial study during my MA in Anthrozoology to gain an insight into the visitors learning experience at one of South Africa's African penguin tourism spots, Stony Point Nature Reserve. Interviews with the visitors revealed that 10% of the visitors learnt about African penguin conservation, 83% had never heard of SANCCOB, and 50% were unaware that African penguins were endangered, and those that did, were aware prior to their visit.

This study highlights the need for improved education during African penguin tourism.

39. GERALDENE, Beth

Breeding management of little penguins (*Eudyptula minor*) in a captive setting: A case study of fostering chicks

Authors: Beth Geraldene

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(1) Zoos Victoria, Australia

(2) Melbourne Zoo, Australia

Abstract: The captive management of a breeding population of little penguins (*Eudyptula minor*) often requires innovative thinking as little or no current research exists to aid in negotiating problems that arise. Between 2010 and 2016 Melbourne Zoo recorded variable chick survival rates in its colony. This study identified parents neglecting their chicks as one cause that attributed to this. Fostering of chicks is a relatively undocumented form of management intervention but was trialled during the 2016 breeding season in an effort to increase chick survival rate. The results of the trial were that little penguin chicks could be fostered under surrogate little penguin parents under specific parameters. More trials are recommended to ensure the reliability of this management technique. It is hoped that the findings of this study will encourage the use of fostering chicks as a recognised management tool and be accepted as good husbandry practise worldwide.

40. GELDENHUYS, Deon

Unmanned Aerial Vehicles for monitoring threatened penguin populations

Authors: Geldenhuys D, McInnes AM, Waller , LJ

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- (5) The Department of Biodiversity and Conservation Biology, University of the Western Cape, Bellville 7535, South Africa

Abstract: The decline in the African penguin population has been well documented, such that the species is now listed as Endangered. Management of this species depends on the accurate and consistent collection of population census data. This is hampered by the physical nature of the colony and the sensitivity of breeding African penguins and other seabirds to observer disturbance and associated increases in predation by Kelp Gulls.

The rapid development of low cost Unmanned Aerial Vehicles (UAV) and associated software have revolutionised remote sensing applications with the ability to record images at high spatial and temporal resolutions while minimising disturbance to the target species. Here we present the application of UAVs to count breeding African penguins at their southern most colony at Dyer Island, South Africa. UAV counts were compared to traditional ground counts with a 10 and 11 % improvement in accuracy for UAV counts of breeding adults and chicks respectively. In addition to minimising disturbance and improving the accuracy of counts, accurate geo-referenced count data enables managers to track spatio-temporal changes in the distribution of the population at a resolution that presents a number of opportunities to effectively manage threatened seabird populations.

41. GODOY REYES, Claudia

Declines of population size and breeding performance of Magellanic penguins (*Spheniscus magellanicus*) in Magallanes Region, Southern Chile

Authors: Claudia Godoy Reyes (1), Luis Muñoz Peralta (1), Pablo García Borboroglu (1,2)

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Abstract: Magellanic penguins (*Spheniscus magellanicus*) breed along the southern coast of South America, from Islote Pájaro Niños in Chile (33°21'S) to Complejo Islote Lobos in Argentina (41°33'S). The largest colony known in Chile is located at Isla Magdalena (IM) (52°55'S), Monumento Natural Los Pingüinos, located at the Magellan Strait and the only one mainland colony is in Seno Otway (SO) (52°58'S). The colonies of this species show mixed population growth trends in different regions of its distribution and in many areas this information is missing. We present the results of our monitoring program, updating the population size for these colonies in the southern extreme of Chile and breeding performance of IM. For IM, population estimates were conducted through circular plots of 100sqm in 2011, 2014, 2017, and 2018 and for SO through direct count in 2014. Breeding success was estimated following 74 to 207 nests during the reproductive seasons. Population size of both colonies showed a remarkable decline compared to previous reports: 85,4% for IM(2018) from 2007 and 89% for SO(2014) from 2003. Nesting density in our 30 sample plots decreased from 0,083 nest/sqm (2011) to 0,016 nest/sqm (2018). Breeding success was similar in the seasons, from 0,97 (2017) to 1,08 (2011). Depending of the year the cause of loss of chicks and eggs were predation and rain. A redistribution of this species has been reported for other latitudes and it is crucial to continue monitoring these colonies and conduct studies to increase our understanding of the drivers of these population decline.

42. GODOY REYES, Claudia

Causes of mortalities of King penguins in a recently established colony in Southern Chile

Authors: Claudia Godoy Reyes (1,2), Luis Muñoz Peralta (1,2), Pablo García Borboroglu (1,3)

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Abstract: King penguin breed on sub-Antarctic islands between latitude 45oS and 55oS. In 2010, a new colony was established at Bahía Inútil, Tierra del Fuego, Chile. The king has the longest annual cycle of any of the penguins, taking fourteen months to rear one chick. Breeding success was extremely low, with complete breeding failures for many years. Our goal was to assess the causes of chick death from 2014 to 2018. We performed post mortem examination and classified the external macroscopic signs as non-infectious (starvation, predation or unknown) or infectious. We performed necropsies on 80% of all dead chicks, registering age and morphological measures and conducting viral and histopathological analysis. In four years, most chicks died before 3 months-old due to outbreaks of infectious diseases. However, this pattern was not consistent among all years, since in 2017 most chicks (55%) died older than 5 months old and predated by grey foxes, an introduced species. The main macroscopic signs were hepatomegaly and enteritis, but it was not possible in all of the cases to precise the principal infectious agent. Infectious disease is one of the main causes of mortality in wild animals worldwide. Few studies have monitored studies on infectious signs on wild penguin populations, and this is the first one on king penguins. Our study is the starting point of a long-term health surveillance program, which is essential to detect emergent pathogens.

43. GOLDSWORTHY, Rosalie

Restricting penguins instead of people: a mitigation of the impact of uncontrolled visitors on yellow-eyed penguins

Authors: Rosalie Goldsworthy, Hiltrun Ratz, Chris Lalas

Author Affiliation:

Penguin Rescue, New Zealand

Abstract: Katiki Point is a c.10ha reserve at North Otago, South Island, New Zealand, jointly administered by the Department of Conservation (DOC) and Ngai Tahu, indigenous owners of most of the reserve. This headland had unrestricted public access and no penguins when founders of Penguin Rescue began conservation management of local seabirds in 1982. We created a breeding colony of yellow-eyed penguins (*Megadyptes antipodes*) initiated by rehabilitated birds in 1991. Nest numbers have risen and fluctuated from an initial two nests to a peak of 34 nests in 2014, finishing with 23 nests in 2018 at an overall deterministic average annual increase of 9% through 28 years. Visitor numbers exceeded 10,000 annually through the last decade, an influx attributable to accolades in TripAdvisor extolling free close-up viewing of penguins. A substantial impact was first recorded in 2014 with a drastic reduction in penguin breeding success. This affected pairs with nests or with access routes from the sea within 10m of visitor paths. Following a DOC recommendation an internal fence was built reducing the proximity of people to penguin that decreased the available breeding habitat for penguins by c.40%. The administrators of the reserve further mitigated disturbance by realigning public paths away from most nests and by closing access overnight. However, the impacts persist and require ongoing mitigation, an unacceptable outcome for the future of this colony that accounts for 10% of the South Island population. Here an endangered species has been compromised in favour of free public viewing.

44. GONZALEZ OLVERA, Merit

ELIGIBLE FOR STUDENT POSTER AWARD

Plasmodium spp prevalence and lineages found in birds and mosquitoes in a zoo from UK during an avian malaria outbreak

Authors: Merit Gonzalez Olvera (1), Arturo Hernandez Colina (2), Andrew Jackson (1), Mathew Baylis (2), Javier Lopez (3)

Author Affiliation:

(1) Institute of Infection and Global Health, University of Liverpool, UK

(2) Institute of Epidemiology and Public Health, University of Liverpool, UK

(3) Chester Zoo, UK

Abstract: Avian malaria, caused by *Plasmodium* spp., is a major threat to penguins in captivity that has produced several outbreaks worldwide. Nevertheless, many aspects of its epidemiology and genetics remain unknown, thus we carried out a study in the UK collecting mosquitoes and tissue samples from dead birds in Chester Zoo through 2017. We tested all samples for *Plasmodium* by a nested PCR. The mosquitoes showed a prevalence of 5% at the beginning of their activity season (May, June) but during the peak of the season (July) the prevalence reached 28%. From the wild birds collected (n=76) only one blackbird recovered in June was infected. Regarding the birds from the zoo's collection (n=88), five penguins were infected. The penguins were moved from their exhibit in September, started showing disease signs in October and half of them died by the end of November; from those, 25% were infected with *Plasmodium*. For all birds, only one species of parasite was found, *Plasmodium matutinum*; in the mosquitoes, three main species were found, *P. matutinum*, *P. vaughni* and *P. relictum*; the first of these being predominant. The only species involved in the penguin's mortality, *P. matutinum*, is a European species that in general is not considered highly pathogenic, but this is the first time that it has been associated with an avian malaria outbreak. There's a need for constant surveillance to have a better understanding of avian malaria and critical knowledge to prevent the disease in susceptible species.

45. GOWNARIS, Natasha

Sex ratio is variable and increasingly male-based at two colonies of Magellanic penguins

Authors: Natasha Gownaris, Dee Boersma

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Abstract: Sex ratios are commonly skewed and variable in wild populations, but few studies track temporal trends in sex ratio. We examined sex ratio patterns at two breeding colonies (Punta Tombo and Cabos Dos Bahias) of Magellanic penguins (*Spheniscus magellanicus*) in Chubut, Argentina. Though these colonies vary in size and breeding habitat, penguins from the two colonies spend their non-breeding season in the same region. Previous research at Punta Tombo has shown that female penguins have lower survival rates than male penguins during the non-breeding season, especially when oceanographic conditions are unfavorable. Furthermore, though male and female Magellanic penguin chicks survive at similar rates, male chicks fledge at a larger size.

We predicted similar trends in sex ratio at Punta Tombo and Cabos Dos Bahias (Prediction 1) driven by variation in the number of females returning (Prediction 2), poorer female reproductive performance in years when fewer females returned to breed (Prediction 3), and more male fights and lower male breeding rates in years when sex ratio was more male-biased (Prediction 4). We found support for all but Prediction 3 (poor breeding success when fewer females return). Our results suggest females breeding in years when few females return, an indicator of unfavorable non-breeding season conditions, may be of high quality. Nonbreeders influence colony dynamics and skewed sex ratios can mask population declines, consequently, effective conservation of wild populations requires tracking adult sex ratios.

46. GRAHAM, Kevin

Using Artificial Nests to Improve Breeding Success of Endangered African Penguins

Authors: Kevin Graham, Trudi Malan, John Werth, Patricia McGill

Author Affiliation:

Dallas Zoo, Dyer Island Conservation Trust (DICT), Pan-African Association of Zoos and Aquaria (PAAZA), Association of Zoos and Aquariums Saving Animals From Extinction (AZA-SAFE), USA

Abstract: Due in part to human destruction of guano fields historically utilized by African penguins to create their nest burrows, the species has suffered a dramatic decline of more than 98% in the past century. The penguins began selecting improvised nesting locations, typically exposed and leaving eggs and chicks vulnerable to human activity, predators and the elements. The drastic decline of the species clearly shows a grave risk of extinction that merits urgent conservation action. The Association of Zoos and Aquariums' Saving Animals From Extinction (AZA-SAFE) artificial nest development program has united experienced professionals from accredited zoos and aquariums in addition to researchers, field biologists, and other specialized scientific fields in order to provide a usable nest option. Species requirements were thoroughly researched; both materials and design were tested to find an option to emulate the complex environmental behavior of guano burrows. Extensive testing of various prototype combinations led to a final design that has yielded not only ideal interior environmental conditions but also extremely high first year usage and success rates in two test colonies compared to both exposed nests and previously supplied artificial nests. The current phase of the artificial nest development project is scaling up production so that these nests can be placed in sufficient numbers in appropriate colonies across South Africa and Namibia. This large-scale implementation will potentially allow thousands of penguin pairs access to suitable nesting locations. The ultimate goal of the artificial nest project is to improve breeding success and contribute positively to population stability.

47. HANDLEY, Jonathan

Conserving penguins at sea: From penguin tracking data to conservation outcomes

Authors: Jonathan Handley (1), Lizzie Pearmain (1), Steffen Opper (2), Norman Ratcliffe (3), Iain Staniland (3), Phil Trathan (3), Carolina Hazin (1), Maria Dias (1)

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(3) British Antarctic Survey. High Cross, Madingley Road, Cambridge, UK

Abstract: Marine conservation necessitates regulation of harvesting so that it does not compromise protection of species, communities and ecosystems. The UN Convention on Biological Diversity Aichi Targets 6 and 11, and UN Sustainable Development Goal 14 define key global priorities that bind nations to achieving this objective. To demonstrate this at a significant marine biodiversity hotspot, we collated 525 GPS and PTT tracks during the breeding and non-breeding period of five penguin species (Adélie, Chinstrap, Gentoo, King, Macaroni Penguins), and an additional 1826 tracks of seven procellariiformes and two pinnipeds, breeding at seven major locations at South Georgia and the South Sandwich Islands (SGSSI). We used these data to identify sites important to the global persistence of biodiversity (Important Bird and Biodiversity Areas - IBAs, and Key Biodiversity Areas - KBAs). We did this based on standardised approaches for identifying IBAs: i) tracking data approach, ii) the foraging radius approach, and iii) species distribution models. We identified priority conservation sites, including eight for penguins, with 21 in total. We considered the effectiveness of the SGSSI marine protected area (MPA) in the context of three important fisheries. We show that the SGSSI MPA is effective for the long-term preservation of penguin species and other predators, and that resource harvesting within the SGSSI MPA does not pose a major threat. Our results contributed to a recent review of the SGSSI MPA, providing evidence for enhancing protection for species, including penguins, in a revised management framework.

48. HERNÁNDEZ-COLINA, Arturo

ELIGIBLE FOR STUDENT POSTER AWARD

Epidemiology and vectors of avian malaria in relation to penguins under human care in the UK

Authors: Arturo Hernández-Colina (1), Merit González-Olvera (1), Emily Lomax (2), Javier López (3), Lindsay Eckley (3), Matthew Baylis (1)

Author Affiliation:

(1) Institute of Infection and Global Health, University of Liverpool, United Kingdom

(2) Medical School, University of Exeter, United Kingdom

(3) Chester Zoo, United Kingdom

Abstract: The vector-borne parasites from the genus *Plasmodium* may cause a subclinical infection in wild birds which affects individual fitness but can also cause avian malaria with unspecific clinical signs, limiting the distribution of wild bird populations and even leading to the extinction of some susceptible species. Avian malaria is also a major cause of mass mortality in captive penguins.

We investigated the epidemiology of avian malaria by capturing mosquitoes weekly in Chester Zoo (Cheshire) and Flamingo Land (Yorkshire) during 2017 and 2018. Both zoos have Humboldt penguins (*Spheniscus humboldti*) which are highly susceptible to the infection. We identified the mosquitoes by morphology and PCR, screened them by nested-PCR for the parasite and analysed the blood inside their abdomens with another nested-PCR to explore host preferences.

We collected over 11800 mosquitoes, from which *Culex pipiens*, the main avian malaria vector, constituted 95%. The overall *Plasmodium* prevalence was around 2.9% (primarily *P. matutinum*). Many of the mosquitoes fed on birds but, unexpectedly, many others fed on humans. The mosquito flying distances were highly variable; thus the control measures should go beyond the areas of concern.

We found differences in the mosquito abundance and feeding behaviour by areas in the zoos, months, years and sites; meaning that their activity varies in the local and regional scales. Therefore, the particular local conditions should be considered to establish effective measures for the mosquito population control and the surveillance and prevention programs for avian malaria, which has been done by the collaborating zoos.

49. HOLT, Katie

ELIGIBLE FOR STUDENT POSTER AWARD

Extreme Heat Mortality of Magellanic Penguins

Authors: Katie Holt, Ginger Rebstock, Anna Sulc, Marya Silvernale, P. Dee Boersma

Author Affiliation:

Center for Ecosystem Sentinels, Dept. of Biology, University of Washington, 24 Kincaid Hall, Seattle, WA 98195

Abstract: We present the direct effects of an extremely hot day (44°C, January 19, 2019) on one of the largest Magellanic penguin (*Spheniscus magellanicus*) colonies, Punta Tombo, Argentina. The colony experienced the most heat mortality and the highest air temperature, recorded in the shade, since 1983. We found 264 dead adults and 90 dead chicks. Heat mortality in the two previous breeding seasons combined were 5 adults and 11 chicks. Adults that died from the heat on January 19, 2019 were in worse body condition than adults that survived ($n_{\text{dead}}=30$, $n_{\text{live}}=74$, $P < 0.001$). Of the dead adults necropsied, 86% had either empty stomachs or $< 50\text{g}$ of food ($n = 21$). Of the dead adults found, 27% were traveling between the nesting area and the water. In prior years, adults died from heat when temperatures were between 26°C and 43°C ($n = 14$ days). The body conditions of dead and live chicks were similar for chicks on January 19, 2019 ($n_{\text{dead}}=14$, $n_{\text{live}}=47$, $P = 0.58$). Chicks that died from heat had food in their stomachs (mean = $405 \pm 128\text{g}$, $n=14$), suggesting food may have inhibited their ability to thermoregulate. In a southeastern section of the colony, we estimated 5.3% of 1153 adults died compared to 0.7% of 1139 adults in a northwestern section. We estimated more chicks died in the northwestern section (4.47% of 425) than the southeastern (2.8% of 556). The direct costs of increased severity of warm weather on penguins can be severe.

50. JOHNSON, Kathryn

ELIGIBLE FOR STUDENT POSTER AWARD

Marine predation injuries in yellow-eyed penguins (*Megadyptes antipodes*)

Authors: Brett Gartrell (1), Stuart Hunter (1), Wendi Roe (1), Lisa Argilla (2), Mel Young (3), Kathryn Johnson (1)

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(3) University of Otago, Department of Zoology, PO Box 56, Dunedin 9054, New Zealand

Abstract: Marine predation injuries are often observed in yellow-eyed penguins (*Megadyptes antipodes*), implicated as shark, sea lion and a potentially an unknown predator attack, presumed to be barracouta (*Thyrstites atun*). Most injuries are observed to the feet and legs, with occasional injuries also identified on the flippers and body. If left untreated, many of these injuries may progress from uncomplicated infected skin lacerations to tenosynovitis, tendon rupture or osteomyelitis, often leading to the demise and death of the animal. The scope of my study will involve investigating the temporospatial occurrence of such injuries in yellow-eyed penguin populations both prospectively, through observations made in 2018, as well as retrospectively, through prior observations. The preliminary results of our research have shown that a high proportion of yellow-eyed penguins from mainland populations display either characteristic scars or active wounds consistent with marine predator attacks. The study will also involve reviewing clinical and pathological findings from these injuries, as well as treatment regimes undertaken with respect to outcomes obtained (death/euthanasia, released, resighted, rebreeding) in order to provide sound recommendations for the optimal treatment of such injuries to maximise the survival and future breeding success of the birds. With the recent discovery of a predator tooth in a wound, and by reviewing the pathology of individual injuries, it is hoped that we will be able to confirm the identity of the unknown predator to better understand the mechanisms behind the attacks.

51. KAGAN, Ron

Developing Partnerships with the Detroit Zoological Society and Polar Oceans Research Group to Advance Penguin Field Science and Conservation

Authors: Ron Kagan (1), Bill Fraser (2)

Author Affiliation:

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(2) Polar Oceans Research Group, USA

Abstract: A critical goal of the Detroit Zoological Society's (DZS) Polk Penguin Conservation Center (PPCC) is to help wild penguins by increasing public awareness of the threats they face, using innovative technologies and amazing penguin viewing experiences, and by further strengthening DZS's engagement with and support of penguin field scientists. DZS has long supported penguin field research and conservation efforts, including support for SANCCOB's seabird rescue and for the Center of Ecosystem Sentinels' work with Galapagos penguins, but the PPCC provided opportunities to expand direct engagement with and support of Antarctic and sub-Antarctic penguins, including with Polar Oceans Research Group and Falkland Conservation.

While many zoological institutions support African and Humboldt penguin conservation, few zoos have worked with organizations operating in Antarctica. DZS engaged Bill Fraser of Polar Oceans Research Group (PORG) in the design of PPCC's Antarctic experience for both penguins and zoo visitors, which led to both financial and staff support of Dr. Fraser's research on the Western Antarctic Peninsula. DZS staff have the unique opportunity to work as part of PORG field teams at Palmer Station, Antarctica, assisting in all aspects of the research, including demography, breeding biology and foraging ecology. This presentation will share DZS' development of important relationships with NGOs, and PORG in particular, that support and advance research with funding and personnel, provide key opportunities for staff working with penguins in zoos to contribute to field science, and provide unique and engaging opportunities that reach zoo audiences with compelling "first person" conservation stories.

52. LALAS, Chris

Prey switching by yellow-eyed penguins attributable to recreational over-fishing?

Authors: Chris Lalas, Hiltrun Ratz

Author Affiliation: Penguin Rescue, Katiki Point Lighthouse, RD2, Palmerston, New Zealand

Abstract: Blue cod (*Paraperca colias*) is the most important marine recreational fishing species around South Island, New Zealand. It accounts for 63% of the recreational catch at North Otago where published surveys found increases in undersized cod caught (16–30cm), 50% in 2005 and 41% in 2011. Increased abundance of small cod was attributed to fishing pressure. Previous diet studies on yellow-eyed penguins (*Megadyptes antipodes*) 40–50km further south at Otago Peninsula found blue cod numerically accounted for 1% of prey in 1984–86 and 2% of prey in 1991–94 from flushed stomachs, and 24% in 2016 from penguin-borne cameras. The likelihood of an increased importance of blue cod in the penguin diet through time is further supported at Moeraki, North Otago, where 159 cod (average=21cm, range=8–31cm) accounted for 48% of prey represented in 83% of 47 adult casts in the 2014 season. Timing of the prey switch to blue cod was deduced from analysis of the contents of food spilt when adults feed chicks. We systematically collected spills from Otago Peninsula through 16 seasons, 1997–2012, then from Moeraki through five seasons, 2014–2018. Blue cod remains occurred in 66% of 290 spills, with calculated length remaining similar through time (262 fish, average=22cm, range=9–30cm). A logistic model indicated increase in average occurrence of cod in spills from 29% in 1997 to an asymptote of 69% since 2006. Implications of this prey switch extend beyond penguin biology to include fisheries interactions and penguins as a pariah for fishers.

53. LE GUEN, Camille

ELIGIBLE FOR STUDENT POSTER AWARD

Microplastic study reveals the presence of microfibres in an Antarctic marine predator: the King Penguin (*Aptenodytes patagonicus*)

Authors: Camille Le Guen, Giuseppe Suaria, Richard Sherley, Stefano Aliani, Lars Boehme, Peter G. Ryan, Andrew S. Brierley

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Abstract: At a time when marine ecosystems are experiencing strong disturbances due to climate change and overfishing, plastic pollution appears as an additional threat. Microfibres are among the most pervasive microplastic pollutants. Among the few microplastic studies in the Southern Ocean, evidence for microfibre contamination in the diet of Antarctic predators is rare. Microplastics are concentrated in surface waters and sediments but can also be retained within fish. Many mesopelagic fish undergo diel vertical migrations, possibly acting as a source of microplastics contamination for diving predators feeding at depth such as King Penguins (*Aptenodytes patagonicus*). Fifty King Penguin faecal samples were collected at South Georgia across three breeding stages: non-breeding, incubating and chick-rearing. After a KOH digestion to dissolve the organic matter and a density separation step using a NaCl solution, the samples were filtered. All fibres retained (n=330) were measured and characterized using Fourier-Transform Infrared (FTIR) spectroscopy to determine their polymeric identity. Most fibres (91.1%) were made of cellulosic materials (i.e. cotton, linen), while the remaining fibres were purely synthetic (i.e. polyester, nylon). This finding might reflect the isolation of the Southern Ocean and its low degradation rates. On average, 4.29 ± 0.89 microfibres per gram of guano were found. Concentrations of microfibres were two times higher in penguins incubating eggs than in penguins rearing chicks. Incubating birds travel longer distances and forage at the Polar Front. Therefore, the Polar Front and the Antarctic Circumpolar Current appear to act as traps for microfibres, which provide a potential signature for foraging.

54. LONG, Robin

ELIGIBLE FOR STUDENT POSTER AWARD

South Westland tawaki surveys: results and learnings

Authors: Robin Long

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West Coast Penguin Trust, New Zealand

Abstract: The Tawaki or Fiordland Crested Penguin, *Eudyptes pachyrhynchus*, is one of the rarest and least researched penguin species in the world, classified as nationally vulnerable with an estimated population of 2500-3000 breeding pairs. Tawaki breed in very remote and difficult to access areas along the coast of South Westland, Fiordland and Stewart Island in dense vegetation and are very difficult to locate and so count accurately. Robin long, who grew up at Gorge River in remote South Westland observing a local breeding colony of tawaki, surveyed a 60km stretch of coastline in South Westland and located a minimum of 835 nests. A total of 150 nests was observed in a previous survey of the same coastline. This dramatic difference in results (835 vs. 150) is attributed to difference in survey methods and the surveyor's familiarity with the breeding area, not a population increase. Given these results and the difficulty involved in locating tawaki, it is likely that the species' overall population size has been significantly underestimated. Considerable experience is needed to accurately census tawaki as colony composition varies with change in habitat and individual pairs may choose particularly inaccessible nests sites, making a complete census of the species practically and economically impossible. Robin intends to continue to repeat this survey regularly using GPS to assess population trends in the area.

55. LUDYNIA, Katta

Taking the AZA/SAFE African Penguin Disaster Relief Project across the border: South African – Namibian collaborations for Disaster Preparedness and Response

Authors: Jess Philips (1), Christian Triay (2), Katta Ludynia (2,3)

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(3) Department of Biological Sciences, University of Cape Town, Cape Town, South Africa

Abstract: As part of AZA's Saving Animals From Extinction (SAFE) programme, the African penguin was chosen as a signature species and a variety of projects were identified to assist with the conservation of this endangered species in Southern Africa.

With the serious threat of disasters, such as oil spills or disease outbreak, the Disaster Relief Project focuses on five areas, namely: 1) engage with collaborators and stakeholders, 2) support the development of wildlife contingency plans and protocols, 3) facilitate disaster response training, 4) support research and 5) support the purchase of designated disaster response equipment.

While the project has already made significant progress in all these areas in South Africa, the need to extend the project to Namibia was paramount as the African penguin is endemic to both these countries.

During a SAFE funded trip to Namibia, we identified and engaged with key stakeholders from government and local NGOs. The offer to assist with the development of contingency plans and protocols as well as to facilitate training was well received. We identified strategic locations and organizations to store stabilization and rehabilitation equipment to enable a timely disaster response. Funding is now being sourced to provide such equipment.

The trip highlighted the limited resources available in Namibia in case of a disaster but also ignited the potential for trans-boundary collaboration between the South African and Namibian governments and NGOs. We will present on the way forward in developing functional disaster preparedness and response measures for the African penguin along its entire range.

56. LUDYNIA, Katta

Hand-rearing African penguin chicks: a tool for the conservation of an endangered species

Authors: Romy Klusener (1), Renata Hurtado (2), Nola J Parsons (1), Ralph ET Vanstreels (2), Nicola Stander (1), Stephen van der Spur (1), Katta Ludynia (1,3)

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(2) Institute of Research and Rehabilitation of Marine Animals (IPRAM), Cariacica, Espirito Santo, Brazil

(3) Department of Biological Sciences, University of Cape Town, Cape Town, South Africa

Abstract: The African penguin population is at its lowest level in history and a number of conservation actions have been identified and are carried out by a variety of stakeholders to halt the further decline of the species.

The African Penguin Biodiversity Management Plan identifies hand-rearing of wild chicks to bolster the wild population as one of its actions. SANCCOB has been spearheading this intervention, with more than 6000 chicks released back into the wild since 2006 and more than 650 eggs hatched since 2012. Overall release rates for hand-reared chicks are close to 80%.

We will present the procedures followed to allow for such a high success rate, starting with removal and transport of eggs and chicks, incubation and admission of chicks, feeding regimes, housing to proper pre-release conditioning and release criteria.

Rescuing and hand-rearing eggs and chicks has been a successful strategy for African penguins, and might be also applicable for the conservation of other threatened seabird species whose population are critically low or during natural or anthropogenic events that could have disastrous population impacts (e.g. oil spills, disease outbreaks, catastrophic weather events, strong El Niño years, etc.).

57. LUKIES, Kerry

ELIGIBLE FOR STUDENT POSTER AWARD

The stress physiology and foraging ecology of kororā in the wider Hauraki Gulf

Authors: Kerry Lukies (1), Dr. Brendon Dunphy (1), Dr. Todd Landers (2), Dr. Jingjing Zhang (3)

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Abstract: Relatively few studies have been carried out on the northern sub-Species of Kororā/Little Blue Penguin (*Eudyptula minor iredale*) in northern New Zealand. This study compared stable isotopes and levels of stress hormone corticosterone from feather samples as well as nest arrival and departure times between colonies in the wider Hauraki Gulf. Kororā from Motumuka (Lady Alice Island) were tracked during the post-guard stage of breeding and the foraging trajectories saw all individuals travel directly toward the mainland, in line with a seafloor bathymetry of less than fifty metres depth. This was significant as it was the second time Kororā have been tracked in the wider Hauraki Gulf region. The results of the stress physiology and foraging ecology comparison of Kororā have contributed to our understanding of how the species is impacted across an urbanisation gradient on the doorstep of Auckland, New Zealand's largest city.

58. MATTERN, Thomas

Marathon penguins – Reasons and consequences of long-range dispersal in Fiordland penguins/tawaki during the pre-moult period

Authors: Thomas Mattern (1,2,3), Giselle Clarkson (4), Klemens Pütz (5), Pablo Garcia Borboroglu (2,6), Ursula Ellenberg (1), David Houston (7), Robin Long (8), Benno Lüthi (9), Phil Seddon (3)

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Abstract: Migratory species often roam vast distances bringing them into contact with diverse conditions and threats that could play significant roles in their population dynamics. This is especially true if long-range travels occur within crucial stages of a species' annual life-cycle. Crested penguins usually disperse over several hundreds of kilometres after completing the energetically demanding breeding season and in preparation for the annual moult. An understanding of crested penguins' pre-moult dispersal is therefore paramount in order to be able to assess factors affecting individual survival. The Fiordland penguin/tawaki is one of the least studied and rarest penguin species in the world. We successfully satellite tracked the pre-moult dispersal of 17 adult tawaki from a single colony located in the species' northern breeding distribution. Over the course of 8–10 weeks the penguins traveled up to 2,500 km away from their breeding colony, covering total swimming distances of up to 6,800 km. Birds leaving in late November traveled towards the Subtropical Front, whereas penguins that left in December headed further towards the subantarctic front. Water depth, surface current velocity and sea level anomalies had the greatest influence on penguin movements at the subantarctic Front, while sea surface temperature and chlorophyll a concentration were key for birds traveling to the subtropical front. We discuss our findings in the light of anthropogenic activities (or lack thereof) in the regions visited by the penguins as well as the potential consequences of tawaki pre-moult dispersal for the species' breeding distribution on the New Zealand mainland.

59. MATTS, Katie

ELIGIBLE FOR STUDENT POSTER AWARD

Platydyptes: The Paleobiology of an Oligocene Penguin

Authors: Katie Matts, Prof. Ewan Fordyce

Author Affiliation: University of Otago, New Zealand

Abstract: The dense bones of penguins are predisposed to fossilise, producing an excellent record of fossil penguins in New Zealand. Of these, the endemic *Platydyptes* is one of the world's few described genera from the later part of the Oligocene age (~23-25 million years ago), living in shallow seas around the New Zealand archipelago. This genus is one of the most modern of the stem or basal penguins; phylogenies show it as a precursor for the crown radiation of penguins. *Platydyptes* was last reviewed by Simpson in 1971 following Marples' work in 1952. Since then, much new material, both partial skeletons and isolated bones, has been collected. The three named species appear to be distinct, separated from each other initially by size of the humerus (upper wing bone) of mature birds: *P. novaezealandiae* (humerus length = 104mm), *P. amiesi* (hl = 117mm), and *P. marplei* (hl= 93mm). An unnamed possible fourth species has a humerus (hl= 119mm) distinctly broader than the three named species.

Specimens OU22116 and OU22804 both comprise partial skeletons, with OU22806 being only slightly disarticulated. The dimensions of the limbs, torso, and pelvis elucidate the body plan; modern penguin skeletons help with reconstruction, especially for interpolating incomplete vertebral columns. A skeletal reconstruction of *P. novaezealandiae* shows a strikingly long, narrow bill, and a robust strongly arched sternum with overlapping coracoids. The reconstructed bill to vent length estimation of 950mm indicates a medium-sized penguin comparable to living species of *Aptenodyptes*.

60. MAURER, Kyle

Influence of marine debris on African penguins (*Spheniscus demersus*) admitted to a seabird rehabilitation facility, SANCCOB, Cape Town, South Africa between 2008 and 2018

Authors: Kyle Maurer, Katta Ludynia, Albert Snyman

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Southern African Foundation for the Conservation of Coastal Birds (SANCCOB), South Africa

Abstract: Anthropogenic and non-biodegradable materials known collectively as marine debris have been tainting the world's pelagic and coastal waters in an ever increasing manner. Marine debris impacts 44% of seabird species with entanglement and ingestion representing the most frequent of consequences.

The Southern African Foundation for the Conservation of Coastal Birds (SANCCOB) has operated a facility in Cape Town since 1968 which rehabilitates sick, injured, abandoned and oiled seabirds. SANCCOB treats more than 1000 endangered African penguins (*Spheniscus demersus*) annually.

Seabirds are regarded as bioindicators of the marine environment and have been used to understand patterns in particulate debris levels in the oceans. SANCCOB provides an ideal environment to assess the extent of entanglement and ingestion on seabirds along South Africa's coastline.

The study will focus on African penguins admitted to SANCCOB in Cape Town that have been affected by anthropogenic debris over the past decade. This will improve understanding of spatial and temporal trends in entanglement and ingestion. The study will help to identify hotspots and possible sources of coastal pollution which will assist in improving effective management interventions and coastal policies to reduce marine debris along our coastline.

The number of seabirds admitted to SANCCOB with debris related injuries has increased each year from 2013 to 2018. The African penguin was the third most frequently affected species (19%). Entanglement most commonly caused leg and head injuries and ingestion, gastric complications. Fishing related debris and plastic fragments were the dominant debris types impacting African penguins.

61. MICHELOT, Candice

Adélie penguins do not take advantage of close polynyas for their incubation trip foraging activity: evidence from a multi-colony analysis

Authors: Candice Michelot (1), Akiko Kato (1), Thierry Raclot (2), Kozue Shiomi (3), Pauline Goulet (4), Paco Bustamante (5), Gaël Guillou (5), Yan Ropert-Coudert (1)

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Abstract: Sentinel species, like seabirds, are often used to assess the impact of environmental changes in remote ecosystems like Antarctica. However, such an approach often relies on the study of a few well-known populations. Here, we studied the foraging behaviour of incubating Adélie penguins *Pygoscelis adeliae* in two colonies in East Antarctica: the intensively studied colony from Pétrels Island near Dumont d'Urville French station, and that of Cap Bienvenue, 24 km east of Pétrels Island and that has never been studied until now. Comparisons between the 2 sites were conducted during the incubation trips of females in 2016, and males in 2017, using GPS tracking and diet data, as well as daily sea-ice data and bathymetry.

Despite being close to the colonies, Adélie penguins did not preferentially use polynyas. Instead, they targeted the continental slope and the sea-ice edge, even when this one was far from the colonies. In addition, there was no difference in diet between the two colonies. In other words, penguins chose areas where food abundance would be more predictable rather than simply the closest open water areas in which the trophic chain has not yet fully developed at such an early stage in the breeding season. Interestingly, the strategies displayed by the penguins from the two colonies were similar. This suggests a common behaviour across colonies of East Antarctica, although additional sites are necessary to ascertain this.

62. MILLER, Rebecca

ELIGIBLE FOR STUDENT POSTER AWARD

The effects of anthropogenic disturbance on African penguin mainland colonies

Authors: Rebecca J. Miller (1), Lauren J. Waller (2), Gavin W. Maneveldt (1), Lorien Pichegru (3), Richard B. Sherley (4), Juan Schen (5) & Andre Ganswindt (6)

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(6) Mammal Research Institute, Department of Zoology and Entomology, University of Pretoria, Pretoria, South Africa

Abstract: Over the past century the African penguin (*Spheniscus demersus*) population has undergone a severe decline in numbers and range, resulting in the species being listed as Endangered on the IUCN Red List in 2010. Numbers continue to fall due to the wide range of threats facing the species, both natural and anthropogenic. There is concern surrounding the potential impacts of the presence of human activity in and around mainland penguin colonies. These colonies are popular attractions for locals and tourists, potentially resulting in high levels of disturbance to these birds. The colonies are often situated close to residential areas, furthering the potential for disturbance. The aim of this study was to evaluate the impact of anthropogenic disturbance (using distance of boardwalks to nests as a proxy) on African penguins at a mainland colony (Stony Point) in comparison to those at a low disturbance island colony (Robben Island). This was achieved by comparing breeding success, chick condition and faecal glucocorticoid metabolites at the two colonies, which enabled an assessment of stress levels under varying degrees of anthropogenic disturbance. The resulting data will provide information on the existing stress levels in birds to the relevant management authorities to make recommendations on regulations and management at African penguin colonies in order to reduce disturbance to the birds.

63. MORANDINI, Virginia

ELIGIBLE FOR STUDENT POSTER AWARD

First record of feather-loss disorder in an Adélie penguin chick at Cape Crozier, Ross Island: preliminary investigation of its etiological agent

Authors: Virginia Morandini (1), Katie M. Dugger (1,2), Grant Ballard (3), Kara Schmidlin (4), Simona Kraberger (4), Amélie Lescroël (3), Annie Schmidt (3), Megan Elrod (3), David Ainley (5), Arvind Varsani (4,6)

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Abstract: Antarctic penguin chicks have been showing signs of an unknown feather-loss pathology in recent years, which is characterized by premature loss of feathers resulting in exposed bare skin (Barbosa et al 2014, personal communication D. Ainley and G.L. Kooyman). The appearance of all affected chicks is very similar to a feather-loss disorder first recorded in African penguin chicks (*Spheniscus demersus* (L)) from a South Africa in 2006 and 2008, and from Magallanic penguins in Argentina in 2007 (Kane et al. 2010).

It has previously been hypothesized that the causative agent may likely be a virus (Barbosa, 2014). Here we report the first observation of feather loss condition in an Adélie penguin chick at Cape Crozier, Ross Island, Antarctica, during the breeding season of 2018-2019. We were unable to sample the 'diseased' chick due to permit regulations in within an Antarctic specially protected area (ASPA) and we sampled the nest material just after the crèche stage. Using a viral metagenomic approach, we identified a novel circoviruse (family Circoviridae) in the material whose genome sequences clusters with known avian circoviruses. The genome of this circovirus shares ~67% genome-wide pairwise identity with gull circoviruses and thus represents a new species of circovirus. Circoviruses, especially those infecting parrots, result in feather loss, beak deformities and immune suppression. It is likely that this novel circovirus identified in the nest material could be the etiological agent of the feather-loss in the 'diseased' individual. Further studies need to be carried out by sampling feathers and blood of penguins to confirm that this virus is indeed infecting Adélie penguins and possibly other penguin species.

64. MORI, Yoshihisa

Does long handling time cause long mutual display? A measure of stress by handling

Authors: Yoshihisa Mori

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Abstract: To study penguins we often catch and handle the bird. Although we intend to minimize negative effect, handling may be more or less stressful for the birds. In the present study we investigated the relationship between handling time and mutual display performed by the handled bird. In 2007, we investigated diving behaviour of chinstrap penguins at King George Island to attach data loggers. To attach the loggers we took 10 min to 40 min, according to the logger types. After attachment we release the bird close to its nest with its mate, and observed mutual display performed by the mates. Mutual display consists of several times bows and calling. We assumed that longer mutual display duration and more number of bows indicated more stressful. We find that handling time (N=15) was positively correlated weakly but significantly with mutual display duration ($r=0.49$) and number of bows ($r=0.52$). We also find that there were no significant difference in mutual display duration and number of bows between no handling time (normal alternation at a nest) and handling time less than 15min. These findings suggest that long handling should be stressful to penguins, handling shorter than 15 min could have no significant effect. Therefore, handling time in penguins research should be shorter than 15 min.

65. NOJIMA, Daiki

The Captive Population Recovery Efforts and Current Issues by Using Artificial Incubation and Hand Rearing of Little Penguin in Japan

Authors: Daiki Nojima (1), Sotaro Kawakami (1), Tatsuya Yamamoto (2)

Author Affiliation:

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(2) Tama Zoological Park, Japan

Abstract: Captive population of Little penguin (*Eudyptula minor*), in Japan has been decreasing after year 2005 because of a low reproduction rate and other reasons. Also maintaining its population had been an issue. To aim to recover its population, Tokyo Sea Life Park has begun an Artificial Incubation attempt and Hand Rearing since 2014.

Only few cases of the Little penguin Artificial Incubation and Hand Rearing have been reported. Therefore, we have independently developed the setting conditions of temperature, humidity, heat radiation and misting of the incubator. With the setting conditions, 81.5% hatched from 2015 to 2018, of which Hand Rearing Fledgling of the all chicks. Fledgling individuals quickly accustomed with rest of the Little penguins, and no human imprinting by the Hand Rearing was observed.

From the results, increasing its population and development of its stable captive population groups in Japan are possible by proceeding the revised Artificial Incubation and the Hand Rearing.

However, the individuals which have the inbreeding coefficient also have been increased, so that Gene Diversity has been decreased. Therefore, domestic individuals transfers within Japan have to be increased, and introduction of new blood Line is necessary to maintain its population in Japan.

66. OKUBO, Michiko

Population management using studbooks and molecular biological methods for captive penguins in Japan

Authors: Michiko Okubo (1), Daiki Nojima (2), Tatsuya Yamamoto (3), Satoshi Tasaki (4), Masahiro Tomiyama (5), Atsushi Yamada (6)

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Abstract: There are currently over 4,100 penguins belonging to 12 species living in captivity in Japan. Among this captive population, studbook registration is being conducted for 10 penguin species, primarily through the Japanese Association of Zoos and Aquariums (JAZA). This population includes more than 1,800 Humboldt penguins (*Spheniscus humboldti*) and more than 700 African penguins (*Spheniscus demersus*), which are under imminent threat in the wild. As these captive populations are valuable for species conservation, breeding plans based on molecular biological methods are being conducted.

The D-loop and cytochrome b regions of mitochondrial DNA and microsatellite markers of nuclear DNA have been used in diversity analyses of Humboldt and African penguins. Comparisons with previously reported data on wild penguins have shown that genetic diversity has been preserved in Japan.

However, there are variations between facilities in terms of the genetic diversity of populations and pedigree preservation. Facilities that have not renewed their family lines may see a reduction in genetic diversity in the future. Therefore, facilities in Japan promote regular transfers, taking genetic information into account, and periodic monitoring of genetic diversity. Through continued population management based on scientific data, we hope Japan's captive penguin population can serve as a stock, contributing to ex situ conservation.

67. ORBELL, John

Penguin pelt as a substrate for the testing of oil contamination removal efficacy via magnetic particle technology (MPT)

Authors: John D. Orbell, Peter Dann, Stephen W. Bigger, Lawrence N. Ngeh, Linda Diep, Angela Shewan

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Abstract: The evaluation and optimization of both traditional and emerging methods and technologies for the effective removal of oil from wildlife is an important part of rescue and rehabilitation research. This requires controlled scientific testing using appropriate substrates and, in some instances, may require testing on live animals - although the latter is obviously not the preferred option. In this regard, the closer the substrate can be to representing a live animal the better and it can be argued that single feathers and feather clusters are not as good as whole bird models (i.e. carcasses) or animal pelt. Comparative oil removal experiments from all of these substrate types have been carried out, utilizing the emerging technology of "magnetic cleansing" – i.e. magnetic particle technology (MPT). The results of these experiments suggest that, for the Little Penguin (*Eudyptula minor*), the use of pelt has certain advantages over the other substrates. These include, ease of storage and preparation, the ability to warm the pelt so as to conduct experiments that mimic the body temperature of the bird and the ability to clean and reuse (recycle) the pelt without a significant change in its characteristics.

68. PARDO, Celine

Physical Rehabilitation and Therapeutic Medicine in Humboldt Penguins, Woodland Park Zoo – Seattle, WA – USA

Authors: Celine Pardo (1), Harmony Frazier (2)

Author Affiliation:

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(2) Senior Veterinary Technician (LVT), Animal Rehabilitation and Massage Practitioner (CCRP, LSAMP); Animal Health Department, Woodland Park Zoo, USA

Abstract: In March of 2009, twenty Humboldt penguins were acquired from zoos/aquariums around the country to found a new breeding colony at Woodland Park Zoo. Over the course of ten years, these founders have raised three generations of offspring and hatched over seventy chicks in support of the Species Survival Plan promoting genetic diversity. Throughout their lives, members of the colony have sustained health issues common to many. As part of its outstanding animal welfare program, the WPZ veterinary department and animal care staff -in collaboration with area specialists- has helped pioneer the utilization of veterinary rehabilitation medicine to aide in the comprehensive care and comfort of species...including penguins. From hatchlings to geriatrics, common and often age related conditions including osteoarthritis, spondylosis, foot/skin lesions, splayed leg, muscular sprains/strains, and mobility issues are identified and treated. Technological and physical rehabilitation techniques including cold laser light therapy (LLLT), stance analyzers (PAWS-Postural Analysis Weight System), pulsed electromagnetic frequency treatment pads (PEMF), acupuncture/acupressure, and massage -combined with herbal medicine and nutritional supplements- are incorporated into the individuals' overall wellness and management program. Combined, these methods help provide a more effective treatment of common conditions by promoting and stimulating healing, reducing pain and inflammation, increasing mobility, and shortening recovery time of an injury, illness or disease. This poster illustrates therapeutic methods used with Humboldt penguins at WPZ and how they enhance the animals' quality of life at various stages. How staff incorporates conditioning to facilitate treatment methods while encouraging cooperation, interaction, and participation is also highlighted.

69. PASSUNI, Giannina

ELIGIBLE FOR STUDENT POSTER AWARD

Productivity near the biggest colony of African penguins: are the penguins bottom up controlling the nearshore water productivity around the colony?

Authors: Giannina Passuni, Lucien Human, Stuart Riddick, Mfundo Bizani, Shaun Deyzel, Lorien Pichegru

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Abstract: Among seabirds, penguins are major contributors world-wide of nitrogen and phosphorus, excreted in breeding colonies. Through excretion, penguins alter the biogeochemical processes in coastal surface systems and enhance primary production in the neighbouring ecosystems where nutrients are limited. Therefore, the first objective of this study was to measure the amount of nitrogen and phosphorus produced by the world largest African penguin (*Spheniscus demersus*) colony situated at St Croix Island, South Africa. We estimated the amount of nitrogen and phosphorus in the penguin excretion during the breeding and moulting seasons, from a bioenergetic model. In parallel, we measured the water quality (physical oceanographic conditions and dissolved inorganic nitrogen and phosphorus) and production (chlorophyll and zooplankton) in an area close (200m) and far (2km) from the colony eight times a year. We related these values with our estimates of nutrients excreted by penguins, as well as from other sources of nutrients in the area. Nutrient excretion was higher during breeding than moulting, and breeders were major producers (70%) of nitrogen and phosphorus excreted (N: 24 tons/year; P: 4.21 tons/year). Concentrations of nitrogen and phosphorus in the water around the colony were higher during winter and spring, but no differences were found between stations close and far from the colony. Concentrations of nutrients were probably more associated with seasonal coastal upwelling and land-derived loads than with penguin excretion. Nitrogen excreted by penguins was probably more likely to be emitted to the atmosphere, or very close to the colony.

70. PINKERTON, Matthew

Patterns and trends in environmental and ecological (zooplankton) properties of the Southern Ocean between 1997 and 2018

Authors: Matthew H. Pinkerton (1), Moira Decima (1), John Kitchener (2), Kunio Takahashi (3), Karen Robinson (4), Rob Stewart (1), Graham W. Hosie (2)

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Abstract: The following environmental data for the Southern Ocean over the period 1997–2018 were assembled: (1) chlorophyll-a concentration (ocean colour satellites); (2) primary productivity (vertically-generalised productivity model); (3) sea-surface temperature, SST (infrared satellites); (4) SST spatial gradient (indicative of ocean fronts); (5) sea-ice concentration (satellite microwave radiometers); (6) mixed-layer depth (potential density difference from blended numerical models). We present an analysis of spatial patterns, seasonal variations, and long-term trends in these environmental properties.

Environmental data were used to spatially extrapolate measurements of upper-ocean zooplankton over the Southern Ocean. Our analysis was based on the Southern Ocean Continuous Plankton Recorder survey (SO-CPR). The CPR is a plankton sampler which is towed at 10 m depth behind ships. Water enters a small aperture at the front of the CPR body where it passes through a 270 µm filter. Retained zooplankton are collected into formalin and later identified and counted in the laboratory. We used the August 2018 SO-CPR database which included 793 deployments of the CPR covering over 238,000 km of towed distance and counts of 7 billion individual zooplankton. Boosted regression tree models were used to relate environmental properties to zooplankton abundances in six groups: (1) *Copepoda*; (2) *Euphausiidae*; (3) *Foraminifera*; (4) *Fritillaria* spp.; (5) *Pteropoda*; (6) *Oithona* spp. The statistical models provided insights into spatial patterns, seasonal variability, and long-term change of these zooplankton groups. Spatial information on environmental properties and zooplankton abundances in the Southern Ocean are made available to help understanding of change in penguin populations.

71. RATZ, Hiltrun

Little penguins moulting together, stay together, but who owns the house when a pair divorces?

Authors: Hiltrun Ratz

Author Affiliation:

Blue Penguins Pukekura, Otago Peninsula, Dunedin, New Zealand

Abstract: The annual moult by penguins is a period of confinement to land that takes 2.5 weeks by little penguins *Eudyptula minor*. Twice weekly monitoring at Pilots Beach, Otago Peninsula, New Zealand, for three seasons (2016–2018) recorded the presence of penguins in nest boxes while they breed and moult. Prior breeding success has been shown to be unrelated to subsequent divorce in little penguins. The data from three seasons collected at Pilots Beach will be examined to determine whether breeding pairs that moult apart (three options: same time but different site, different time but same site, or different time and different site) have a higher divorce rate than pairs that moult together (same time and same site), potentially making the moult important for maintaining the pair bond. Most penguins spend the duration of the moult in one nest box. The data will be examined to determine whether nest boxes previously used for breeding are more likely to be used by the same pair for moulting, and whether nest boxes used for moulting are more likely to be used for breeding, in the following season by the same pair. Furthermore, in the case of divorce will the male or the female breed in the nest box previously used for either breeding or moulting. If penguins are more likely to use their moult site for the next breeding attempt, this could inform placement of nest boxes to increase the occupancy of new nest boxes in the colony facilitating monitoring.

72. Ratz, Hiltrun

Rehabilitation as a management tool to enhance population size of yellow-eyed penguins

Authors: Hiltrun Ratz, Janice Jones, Rosalie Goldsworthy, Chris Lalas

Author Affiliation:

Penguin Rescue, Katiki Point Lighthouse, RD2, Palmerston, New Zealand

Abstract: Numbers of yellow-eyed penguins (*Megadyptes antipodes*) are decreasing at south-eastern South Island, New Zealand, with a high risk of extirpation within decades. Published records for annual nest numbers 1982–2015 showed large fluctuations; beginning at 453, peaking at 642 in 1996 and ending at 256 nests. This equated to an overall deterministic average annual decrease of 2% through the 34 years. Intensive management at Moeraki, North Otago, by Penguin Rescue through the same period began at six nests (1% total), peaked at 58 in 2013 and 2014 and ended at 46 nests (18% total), at an overall deterministic average annual increase of 6%. Rehabilitation of compromised penguins began at Moeraki in 1984. We will calculate the minimum impact of rehabilitation on the Moeraki population in 2018 not only by subtracting any breeding that followed rehabilitation of marked female juveniles or adults but also by subtracting any breeding by their female descendants. Just now we have comprehensive results only to 2006, by which time 14 females nested at Moeraki after rehabilitation (and another four nested elsewhere). The 43 nests at Moeraki in 2006 included six (14%) rehabilitated marked females and seven of their female descendants: their subtraction reduced number of nests by 30% to 30 nests. Techniques have evolved throughout the rehabilitation process and will be expressed as increases in female breeder survival and increased female recruitment; e.g. through the most recent four years, an average 53% of female breeders and a total 60% of female recruits had been previously rehabilitated.

73. REINHOLD, Sarah-Lena

ELIGIBLE FOR STUDENT POSTER AWARD

Inter-continental variations in Long-Nosed Fur Seal predation of Little Penguins

Authors: Sarah-Lena Reinhold (1), Simon Goldsworthy (1,2), Sean Connell (1), Rebecca McIntosh (3)

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(2) South Australian Research and Development Institute (SARDI), 2 Hamra Ave, West beach, SA 5024

(3) Phillip Island Nature Parks, 2115 Phillip Island Rd, Cowes, VIC 3922

Abstract: There has been much uncertainty surrounding the status of Little Penguin *Eudyptula minor* populations and the impacts of predation by Long-Nosed Fur Seals (LNFS) *Arctocephalus forsteri* in Australia. Several Little Penguin colonies in eastern South Australia and western Victoria have experienced severe declines and many no longer exist. Following almost 150 years of low population numbers, LNFS pup production in South Australia has increased by more than 3.5 times since the 1980's with breeding distribution continuing to expand. This research investigates the predator-prey relationship between LNFS and Little Penguins across the sympatric range of these species. Synthesis of 25 LNFS dietary studies dating from 1948-2019 for Australia and New Zealand demonstrate a diverse contribution of Little Penguins to LNFS diet across Australia (0-50% FO). Comparatively in New Zealand, only two out of 11 LNFS dietary studies detected Little Penguin predation and at low frequencies (FO \leq 1% per study). During this study-800 LNFS scats were collected across 20 Australian sites. Three haulouts in South Australia and Victoria, predominated by sub-adult males and juveniles, were identified as Little penguin predation hotspots (34-50% FO). Scat sampling experiments also found penguin predation was over-represented in scats following random sampling (43% FO) compared to scat collection over three-day sampling intervals (~13%). This is the first study to investigate the contribution of Little Penguins in LNFS diet at an inter-continental scale and highlights the spatial and demographic variation of LNFS foraging strategies, as well as key biases associated with quantifying Little Penguin predation pressure.

74. ROBB, Elvira

Finding Little Blue Citizen Science Project

Authors: Elvira Robb

Author Affiliation:

Nga Motu Marine Reserve Society Contractor, New Zealand

Abstract: Finding Little Blue is an exciting little blue penguin monitoring project funded by Curious Minds and lead by citizen scientists from all over Taranaki, New Zealand.

Students scientists from local schools have developed and tested the monitoring technology to apply to little blue penguin burrows around North Taranaki. This non-invasive burrow monitoring method allows the wider community to see from the comfort of their own homes just how often and how long the penguins are using their nests. We are so excited to be working work with our student citizen scientists with extra help from various other community groups and schools!

This project aims to:

- Raise awareness of Taranaki little blue penguins and the environmental threats they deal with
- Encourage people to be more responsible with controlling their dogs on beaches
- Streamline useful and meaningful data about our local Taranaki little blue penguin populations
- Provide ongoing and accurate data for important entities such as tertiary institutions and government organizations for coastal planning and development

This project is supported by the Nga Motu Marine Reserve Society, Curious Minds, Port Taranaki, Taranaki Regional Council, New Plymouth District Council and Ngati Mutunga Iwi and Te Atiawa Iwi.

75. ROUYER, Marie-Morgane

ELIGIBLE FOR STUDENT POSTER AWARD

Conserving Antarctic penguins: identification of critical sites in support of the Antarctic MPA network

Authors: Marie-Morgane Rouyer (1), Maria Dias (2), Aldina Franco (1), Jonathan Handley (2)

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(2) BirdLife International. The David Attenborough Building, Pembroke Street, Cambridge CB2 3QZ, UK

Abstract: For the conservation of species and biodiversity, it is imperative to identify sites that will contribute significantly to their global persistence. Important Bird and Biodiversity Areas (IBAs) are a recognised conservation tool, based on global criteria, to locate such sites. Terrestrial IBAs have been identified for the four key penguin species of Antarctica: Adélie (*Pygoscelis adeliae*), Chinstrap (*Pygoscelis antarcticus*), Gentoo (*Pygoscelis papua*) and Emperor (*Aptenodytes forsteri*) penguins. Considering the increased anthropogenic pressures in Antarctic waters, we identified the marine IBAs (mIBAs) for these species. Firstly, we collated population estimates from 783 breeding colonies to identify those colonies which trigger > 1% of the global population (IBA criteria A4). Secondly, we used a mean-maximum foraging radius approach from those colonies to identify mIBAs. The identification of these sites will support the currently proposed marine protected area (MPA) network in Antarctica. Furthermore, these objectively defined sites serve a critical role toward meeting key global marine conservation targets such as the UN Convention on Biological Diversity Aichi Targets 6 and 11, and UN Sustainable Development Goal 14.

76. SCHNEIDER, Tom

The Polk Penguin Conservation Center - Ensuring the Wellbeing of Penguins, the Work of Field Scientists and the Experiences of Zoo Visitors

Authors: Ron Kagan (1), Tom Schneider (2)

Author Affiliation:

(1) Detroit Zoological Society, USA

(2) Detroit Zoological Society, AZA Penguin Taxon Advisory Group Chair, USA

Abstract: The Penguinarium, one of the first facilities in the world built specifically for cold-weather penguins, opened at the Detroit Zoo in 1968. A pioneering facility for its time, it provided temperature control, filtered air, and a 130,000-liter pool with water chilled to 4° C and underwater viewing for visitors. In 2016, the Detroit Zoological Society reestablished state-of-the-art for captive penguin care and welfare with the award-winning Polk Penguin Conservation Center (PPCC) and set new standards of achievement for penguin environments in zoos, and for what zoo visitors experience and learn.

Two years of study and design, which included Antarctic ecologist Bill Fraser, culminated in the world's largest captive penguin facility, with over 1.2 million liters of water, diverse land elements, varied nesting sites, snow and waves. Visitors have multiple above- and below-water viewing opportunities, including 15 meters of underwater tunnels, and they experience the extreme conditions penguins encounter through digital projection and 4-D technology.

Research has been a critical component of the DZS' animal and education programs. DZS's Center for Zoo and Aquarium Animal Welfare and Ethics conducted research on penguin behavior in the old Penguinarium and in the PPCC to understand impacts of the new facility on penguin behavior, health and welfare. This research is critical to understanding how penguins fare in captive facilities and to advancing captive standards. Research on what the more than three million visitors to the PPCC have experienced and learned informs interpretive program development for DZS and other informal science learning institutions.

77. SHEWAN, Angela

ELIGIBLE FOR STUDENT POSTER AWARD

The development of a novel method for removing “recalcitrant” oil contamination from wildlife

Authors: Angela Shewan, Stephen W. Bigger, Lawrence N. Ngeh, Peter Dann, Linda Diep, John D. Orbell

Author Affiliation:

College of Engineering & Science/Institute for Sustainable Industries and Livable Cities (ISILC), Victoria University, Melbourne, Australia

Abstract: A persistent problem in the removal of oil contamination from affected wildlife is that some crude oil contaminants are particularly tarry and sticky. This can arise from weathering or can be an inherent characteristic of the contaminant itself. This problem, and contaminant removal in general, is also greatly compounded when the ambient temperature is low, generally less than around 14 °C. Such temperatures are not unusual for many habitats including the Phillip Island Nature Parks, Victoria, Australia - home to Victoria’s iconic Little Penguin (*Eudyptula minor*) population. This project aims to exploit a recently developed dry cleaning technique based on the use of oil absorbing magnetic particles and involves the concept of developing and testing oil softening/sequestering “magnetic pastes” as pre-treatment agents for the removal of such “recalcitrant” oil contamination. Such agents can be applied deep into the affected plumage and subsequently magnetically harvested together with the contaminant using existing magnetic harvesting technology. An important aspect of this approach is that the paste may be heated and effectively maintained at that temperature due to its iron/oil composition, hence ameliorating the effect of a low ambient temperature and possibly increasing its oil sequestering characteristics. A range of magnetic pastes, formulated from iron powder and potential pre-treatment agents, such as methyl oleate, have been tested for their ability to magnetically remove various recalcitrant contaminants from the plumage of the Little Penguin. Penguin pelt has been utilized as a substrate for this purpose.

78. SNYMAN, Albert

Determinants of external and blood parasite load in African penguins (*Spheniscus demersus*) admitted for rehabilitation

Authors: Albert Snyman, Ralph Eric Thijl Vanstreels, Chandré Nell, Adam M. Schaefer, Thomas Stracke, Nola J. Parsons, Katrin Ludynia, Pierre A. Pistorius

Author Affiliation:

Southern African Foundation for the Conservation of Coastal Birds, Cape Town, South Africa

Abstract: Parasites can lower survival and impact reproductive abilities of birds, whether through direct or indirect impacts. In this study, we investigate the factors determining the occurrence and abundance of external and blood parasite in African penguins, an endangered seabird that breeds exclusively on the coasts of Namibia and South Africa. External parasites were collected using the dust-ruffling method from 171 African Penguins admitted over an 8-month period to a rehabilitation center in the Western Cape, South Africa. Additionally, Giemsa-stained blood smears were obtained upon admission and weekly during rehabilitation and examined for blood parasites. Fleas *Parapsyllus longicornis humboldti*, ticks *Ornithodoros capensis* and lice *Austrogoniodes demersus* were respectively recovered from 93%, 63% and 40% of the penguins upon admission to the center. Rescue location and age group were identified as significant determinants of flea abundance, whereas month of admission was a significant determinant of tick abundance. Blood parasites were also common, with Babesia being by far the most frequent (46% prevalence on admission) whereas Borrelia was recorded sporadically (1.2%) and Plasmodium was recorded once. The prevalence and abundance of ticks on admission was positively associated with Babesia infection on admission. Although similar statistically-significant associations could not be demonstrated for Borrelia infections, all penguins that were Borrelia--positive on admission or that became Borrelia--positive during rehabilitation had ticks on admission. Our findings demonstrate the variability and potential health implications of parasites in an endangered species of penguin, and highlight the need for additional research on the ecological dynamics of these possible disease vectors.

79. STANDER, Nicky

From Bathtub to Government Bill: The changing role of a rehabilitation and conservation organization

Authors: Nicola J. Stander, Christian Triay, Dr. Katta Ludynia, Dr. Lauren Waller, Dr. Stephen van der Spuy

Author Affiliation:

University of Cape Town, South Africa

Abstract: The Southern African Foundation for the Conservation of Coastal Birds (SANCCOB) was established in 1968 by a single person, Althea Westphal, who washed and rehabilitated oiled African penguins in her bathtub at her home in Cape Town. Since then, SANCCOB has extended its footprint and opened a second facility in Port Elizabeth and has admitted over 95,000 seabirds of which about 75,000 have been African penguins since inception. SANCCOB gained world-fame during the MV Treasure Oil Spill in 2000, when 19,000 oiled African penguins were rescued and rehabilitated, still known as the largest animal rescue operation to date.

Rehabilitation remains one of SANCCOB's core functions, however as seabird populations continue to plummet, focus has shifted to pro-active conservation work in the form of bolstering the wild penguin population by hand-rearing abandoned African penguin chicks, providing resources to conservation authorities by deploying Penguin Rangers to several seabird breeding colonies and advising government on developing conservation guidelines and contingency plans to preserve seabird species.

Over the last 50 years, SANCCOB's work has evolved due to the changing environmental and anthropogenic threats facing seabirds thus it has been instrumental in developing the African Penguin Biodiversity Management Plan, guidelines for disease surveillance, hand-rearing and translocation of chicks, predator control and Norms and Standards guidelines for seabirds in captivity. SANCCOB's vast experience in oiled wildlife response has led to SANCCOB being one of the lead authors on South Africa's National Oiled Wildlife Preparedness and Response Contingency Plan, making this non-profit organization an integral stakeholder in conservation and political decision-making in the management of South Africa's seabirds.

80. SUZUKI, Kiyomi

Let's Change The World From The Penguins!

Authors: Kiyomi Suzuki

Author Affiliation:

Penguin Rice Field / Penguin Conference Japan

Abstract: The world is confronted with the environmental problems such as marine plastic, water pollution, extreme weather, deforestation etc. These are deeply concerned with the penguins. I think at time to reconsider our way of life.

Actually I became a organic rice farmer, because it's for the penguins! Agricultural chemicals are made from petroleum. I know that penguins suffer from petroleum pollution. So I don't use that. And I sell the rice called "Penguin Rice" and donate a part of the sales to a penguin protection fund.

This is an example.

I think that we can change the world from the penguins. Also we will be able to solve illegal dumping of the Antarctica in the future, I wish.

How about thinking that together at this time?

81. TIERNEY, Megan

Multi-species analysis of important at-sea areas of penguins breeding at the Falkland Islands

Authors: Dr Alastair Baylis, Dr Megan Tierney, Dr Paul Brickle

Author Affiliation:

South Atlantic Environmental Research Institute

Abstract: The Falkland Islands, South Atlantic, is one of the most important breeding locations on the Patagonian Shelf for colonial seabirds. Several species of penguins breed at the Falkland Islands, including one third of the global population of southern rockhopper penguins and gentoo penguins. Yet, despite the global significance of the Falkland Islands, our understanding of shared patterns in the at-sea distribution of penguins remains poor. Here, we used biologging tags to track the movements of four penguin species breeding at the Falkland Islands (rockhopper, gentoo, magellanic and king penguins). Using Generalized Additive Models, we then modelled the penguins use of space as functions of dynamic and static environmental indices that described habitat. Predicting from these models, we mapped the predicted distribution of animals from both sampled and unsampled colonies and thereby identified areas where multiple species were likely to overlap at sea. Maximum foraging trip distance ranged from 79 km to 1115 km. However, most of the 613 foraging trips made by 278 penguins were restricted to the Patagonian Shelf and shelf slope, which highlighted a preference for shelf and slope waters. Of the seven candidate explanatory covariates used to predict distribution, distance from the colony was retained in models for all species and negatively affected the probability of occurrence. Predicted overlap among species was highest on the Patagonian Shelf around the Falkland Islands and the Burdwood Bank. Crucially, our findings highlight that spatially explicit conservation measures are likely to benefit multiple species, while threats will likely impact multiple species.

82. TRAISNEL, Gwendoline

Poor breeding success induces nest-mate change in African penguins

Authors: Traisnel Gwendoline, Pichegru Lorien

Author Affiliation:

Nelson Mandela University, South Africa

Abstract: In long-lived species, nest and mate fidelity are often linked to factors such as age, environmental conditions, adult sex-ratio (ASR) or past breeding success. Here, we explored one of the mechanisms behind nest and mate fidelity in African Penguin *Spheniscus demersus*, a species with a potential biased ASR. We investigated the win-stay/lose-shift theory, by relating past breeding performances to fidelity, and testing whether a nest or partner change improved subsequent individual breeding performances. Due to a potential biased ASR towards males, we suspected females to be more responsive to their past breeding success, changing nest site and/or partner after low breeding performance. On Bird Island (Algoa Bay, South Africa), we collected information over four consecutive years on chick growth of pairs marked with passive integrated transponders. A total of 108 individuals were sighted at least two years. Pairs with a poor breeding success at year t showed lower nest fidelity in year $t + 1$, supporting the win-stay/lose-switch theory. Breeding performances significantly improved after a nest change, suggesting that the costs of remaining within a poor territory outweighed the costs associated with a change. Female mate fidelity decreased with low breeding success the previous year and reduced nest fidelity, while males' mate fidelity did not. The potential biased ASR towards males in this population may explain this result, as the rarer sex (here the female) may have greater opportunities to re-mate. The present work highlights one of the possible mechanisms behind mate and nest fidelity in this endangered species.

83. TWORKOWSKI, Lauren

ELIGIBLE FOR STUDENT POSTER AWARD

Anthropogenic climate change: Are little penguins feeling the heat?

Authors: Lauren Tworkowski (1), Dr Ursula Ellenberg (1,3), Dr Kylie Robert (1) and Dr Peter Dann (2)

Author Affiliation:

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(2) Phillip Island Nature Parks, Ventnor, Vic. 3922, Australia

(3) Global Penguin Society, 209 Mississippi Street, San Francisco, CA 94107, USA

Abstract: During recent heat waves, increased mortalities of Little Penguins have been observed at Phillip Island in southeastern Australia. Although heat stress has been observed in other life history stages, birds are most susceptible during moult. Penguins undergo a ‘catastrophic’ moult, with all feathers shed and replaced in ~18 days. Penguins fast until the process is complete as they do not have adequate insulation and waterproofing to forage at sea. This means Little Penguins are constrained to land at the hottest time of the year. Long-term data suggest that adult mortality during moult is most prevalent in years when high ambient temperatures are paired with low humidity. Given current climate projections, successful future management of this colony requires a better understanding of the physiological processes and habitat features that influence penguin mortality during heatwaves.

In this study we aim to identify which birds are most at risk during moult, and why. Using a novel approach to field respirometry, we investigate the thermoregulatory costs of moulting birds in response to ambient temperature and humidity. This approach will reduce the need for similar lab experiments and reduce handling and captivity stress. We will also quantify the microclimates of burrows and vegetation types, and investigate how birds are utilising structural habitat during extreme weather events. Results will help determine how birds are currently coping with extreme temperatures on land, predict how this might change under future climate scenarios, and identify adaptation options most likely to reduce negative climate change impacts for the species across their distribution.

84. VELDSMAN, Lu-Marie

ELIGIBLE FOR STUDENT POSTER AWARD

A method to determine the combined effects of climate change (temperature and humidity) and eggshell thickness on water loss from bird eggs

Authors: Lu-marie Veldsman, Henk Bouwman, Henrik Kylin, Petrus Bronkhorst, Ilana Engelbrecht and Henk Bouwman

Author Affiliation:

Research Unit: Environmental Sciences and Management, North-West University, Potchefstroom, South Africa

Abstract: Differences in bird eggshell thicknesses occur due to numerous factors, including thinning due to persistent organic pollutants. Not only does thinning weaken the shell; weaker shells combined with elevated ambient temperature and changes in humidities may result in changes in water loss rates from the egg contents. Therefore, thinner eggshells raise concern of water being lost faster than normal at lower relative humidities, which may affect hatching. To investigate the combined effects, we developed and tested an effective method that measures water loss through different thickness eggshells at controlled temperatures and relative humidities to assist in ascertaining the combined effects of climate change (temperature and humidity) and changes to eggshell thickness on bird reproduction. The fastest rate of loss was at 40% RH at 40°C (0.1 mL / cm² 22 /day), and the slowest was at 22°C at 80% RH (0.02 mL / cm² 23 / day). Eggshell thickness had a significant effect on water loss at all humidity treatments, except at the highest temperature and humidity treatment (80% RH and 40°C). Temperature explained 40% of the variance, RH explained 20%, and interactions between temperature and humidity explained 15% of the variance (repeated-measures, two-way ANOVA). Generalized linear analyses revealed that both factors temperature and humidity contributed significantly in any two-way combinations. We have laid the ground for a system to test the combined effects of temperature and humidity changes associated with climate change and eggshell thinning associated with pollutants, on water loss across eggshells.

85. VIBLANC, Vincent

Lefties or righties ? The evolution of population wide sex-dependent lateralization in king penguins

Authors: Bastien S Lemaire (2), Vincent A Viblanc (1), Christelle Jozet-Alves (2)

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(2) Normandie Univ, UNICAEN, Université de Rennes 1, CNRS, EthoS UMR 6552, F-5 14032 Caen, France

Abstract: Brain and behavioral asymmetries (termed "lateralization"; e.g. preferential eye-use) have been mostly described in controlled laboratory conditions, although striking similarities of hemispheric brain control for specific behaviors have also been shown in the wild. Visual lateralization may provide ecological advantages by allowing complementary roles played by the left-right lateral and frontal visual field in distant or close motion detection of predators or other threats. In this study, we tested for lateralization in aggressive behaviour for wild king penguins (*Aptenodytes patagonicus*), seabirds breeding in a context of extremely strong colonial aggressiveness and subject to on-land based predation of their egg or chick. We show that males initiated more agonistic interactions when a congener was located in their right frontal visual field and in their left lateral visual field. The results obtained in females were the exact opposite for each subdivision of their visual fields. Complementary lateralization in males and females penguins may be part of a more general phenomenon, allowing partners to coordinate their behaviour during reproduction. This may be especially true during the period of courtship, during which these seasonally monogamous and monomorphic seabirds engage in mutual mate choice based on a complex and ritualized display of ornaments located on the left and right lateral sides of the head. Those results open exciting questions as to whether hemispheric control of aggression is a commonly selected phenotypic trait across colonial seabirds.

86. WAGNER, Eric

Penguin tourism: How Many People Are Visiting Wild Penguins?

Authors: Eric L. Wagner, Pablo Garcia Borboroglu, P. Dee Boersma

Author Affiliation:

Center for Ecosystem Sentinels, Department of Biology, University of Washington, Seattle, WA

Abstract: Penguins are popular. If tourists can access them in the wild they will make the journey. Consulting many sources, we found 298 sites that support penguin-related tourism in the wild. Antarctica had the most sites with 123; Namibia had the fewest with one. Every species of penguin is exposed to tourists. Visited colonies ranged in size from more than 1,000,000 breeding pairs (e.g., Macquarie Island, Australia) to fewer than 20 (several sites). While estimates were available for over 90% of sites, they varied in recentness and reliability. Often there was no current information on whether colony size was increasing, stable, or declining. The number of annual visitors was tracked at only 49% of sites, and ranged from >750,000 per year (Phillip Island, Australia) to fewer than twenty (various sites, Antarctica). Excluding Antarctica and the Galápagos Islands, where visits are more closely regulated, less than half of sites had management plans beyond federal wildlife laws. Entrance fees varied, from free to more than US\$100. The fees tourists paid often did not go to support penguin conservation. Guided tours were available at over 90% of sites, but in extreme cases, tourism was so poorly managed that sites became overdeveloped, contributing to declines in local reproductive success. Information for sites was generally sparse, making fundamental questions about tourism sustainability difficult to answer. Penguin-related tourism operates mostly in a black box, with substantial information gaps that need to be filled if tourism is to benefit the penguins people want to see.

87. WASIAK, Paula

Is it worth doing? Little penguin rehabilitation and release on Phillip Island

Authors: Paula Wasiak, Jodi Bellett, Rose Baulch

Author Affiliation:

Phillip Island Nature Parks, Australia

Abstract: Phillip Island, Australia is home of one of the largest colony of Little penguins, with over 32,000 breeding adults. Little penguins have been studied on the island since 1968. As sick and injured penguins were regularly found, a purpose-built Wildlife Clinic opened in the 1980s. Today, the Clinic cares for approximately 150 Little penguins annually, in addition to 300-400 other animals of over 60 different species.

Rehabilitation success is often based on the number of animals successfully released from care. However, the fate of rehabilitated animals is hardly known or reported. Knowing the success of the rehabilitation efforts would allow for an assessment of the resources used as well as an evaluation on whether rehabilitated animals recover from the stress undergone while in care. Here we propose a more accurate indicator of success based on how many individuals are resighted after release. This study looked at how many adult Little penguins were resighted within a 12 year period (2005-2017) after being released from the Wildlife Clinic.

The resight rates of Little penguins after rehabilitation was 49%, compared to 64% resight of control birds (penguins that were not rehabilitated), which was significantly different ($\chi^2(1) = 5.496$, $P=0.0191$).

Although the difference between resights of Clinic and control birds was significantly high, almost half of the rehabilitated birds were sighted again in the breeding colony. Given the increasing number of diseases, incidents with human-penguin interactions and negative effect of climate on penguin food supply, the penguin rehabilitation efforts are worth doing.

88. WEIR, Jodie

Little penguin (*Eudyptula minor*) breeding success 2012 – 2019 in a small Kaikōura colony

Authors: Dr. Jody Suzanne Weir (1,2), Chloe Cargill (1), Alastair Judkins (1)

Author Affiliation:

(1) Kaikōura Ocean Research Institute (KORI), New Zealand

(2) School of Veterinary Sciences, Massey University, New Zealand

Abstract: Little penguin (*Eudyptula minor*) colonies often occur in close proximity to coastal residential areas around New Zealand. From 2012 through 2019, the Kaikōura Ocean Research Institute (KORI) has monitored a small, little-known population in Kaikōura, north Canterbury. Preliminary results indicate an overall decline in breeding success. The main colony occupies an area of less than 250 m², in the immediate vicinity of a commercially operated boat-park, wharf and associated car-park. Bordered on one side by a developing suburban area and bisected by a major slipway, the locale is popular with residents and tourists for recreational activities. Purpose-built nest boxes (PBNBs), artificial 'boulder wall' breakwaters and the foundations of a shorefront building are used regularly by breeding and moulting little penguins. During weekly monitoring, the presence of adult penguins, chicks and eggs is recorded, in addition to date of lay, hatching, end of guard-phase and fledging. Individual adults are identified from flipper-bands. Number of breeding pairs ranged from eight (2015 – 2016) to 12 (2014 – 2015), with a per-season average of 10. In total, 178 eggs were laid, with double-clutches common and maximum lay occurring in the 2017 – 2018 season. Annual hatching success was consistently high, however colony breeding success (defined as the number of fledglings relative to the number of eggs laid) was lowest during the past season (2018 – 2019). Observed declines in breeding success may be attributed in part to local human activity, including habitat depletion, predation and direct disturbance. Habitat protection, expansion, predator control and continued monitoring is recommended.

89. WELLINGTON, Pearl

Foot Color Changes with Age in Magellanic, Humboldt, and Galápagos Penguins

Authors: K. Pearl Wellington (1), John Samaras (2), Katie Holt (1), Caroline Cappello (1), Godfrey Merlen (1), Ginger Rebstock (1), Pablo Borboroglu (1, 3), P. Dee Boersma (1, 3)

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Abstract: Once penguins have adult plumage we have no way to determine their age. Our observations of Magellanic penguins (*Spheniscus magellanicus*) at Punta Tombo, Argentina over the last 35 years showed that foot color blackens with age. To test this, we scored foot color variation in known-age Magellanic, Humboldt (*S. humboldti*), and Galápagos (*S. mendiculus*) penguins. We found that foot color starts as white and eventually becomes black for most individuals. Feet darkened the most rapidly in Galápagos penguins with some birds in juvenile plumage (typically <9 months old) having completely black feet—a coloration we did not observe in Humboldt or Magellanic penguins until 3 and 9 years old, respectively. By the juvenile stage, 64% of Galápagos, 39% of Humboldt, and 13% of Magellanic penguins had mostly black feet (n= 115, n= 92, n= 181). Magellanic penguins retained the white in their feet the longest of the three species. Juvenile Magellanic penguins had mostly white feet (86%, n=181), decreasing to 61% of adults 2-9 years old (n=135), 19% of adults 10-20 years old (n=196), and 4% of adults 20+ years old (n=68). No Magellanic penguins under 9 years old had fully black feet. Due to the gradual blackening in Magellanic penguins, white feet may be as a useful indicator of young penguins. Individual variation in foot color prevents determining an individual's age; however, our results show that foot color could be used to assess whether a breeding colony is made up of mostly old or young adults.

90. WILSON, Kerry-Jayne

Where, how many and why? The distribution and abundance of little penguins in New Zealand

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Abstract: Little penguins (*Eudyptula minor*) occur around most of New Zealand but the only systematic regional surveys have been carried out in Otago (1991-92, 2013) and Banks Peninsula (2000-02). This is the first national effort to map the location of their colonies and attempt to estimate penguin numbers. Little penguins are not evenly distributed around New Zealand. They are more common in eastern New Zealand than in the west. In the east of the North Island they are common in the Bay of Plenty north, but there are just a few small colonies south of Napier with only one known colony in the Wairarapa. In the eastern South Island, little penguins are (or were) numerous on Motunau Island, Banks Peninsula and Otago, but rare in eastern Marlborough and south Canterbury. Along New Zealand's western shores, colonies tend to be smaller and more widely dispersed; even in those areas where little penguins are most common (Far North, Auckland, Taranaki, Wellington, Buller and Okarito). Little penguins are common on both sides of Cook Strait but uncommon in Fiordland and Southland. The southernmost colonies are on Stewart Island where they are thought to be common although the region is poorly surveyed. At the Chatham Islands their distribution is tolerably well known but not their numbers. We will discuss the role both land-based and sea-based threats may have had on influencing the distribution of little penguins.

91. WOOD, Jamie

Refining long-term trends in Adélie Penguin diet and population size within the Ross Sea using ancient DNA

Authors: Jamie Wood (1), Theresa Cole (1,2), Morgan Coleman (1), Phil Lyver (1), Dean Anderson (1)

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Abstract: Adélie penguins have broad diets, yet the abundance and availability of different prey species can affect breeding success and hence population size. Over long time periods (centuries or millennia) other factors such as climate change or sea ice conditions can also have major impacts on Adélie penguin populations. Understanding the dynamics of these interactions will allow better predictions about the future impacts of natural perturbations in the Ross Sea on Adélie penguins, and the effects of management strategies such as the Ross Sea MPA. A significant amount of work has been done with regards to reconstructing diet changes in Adélie penguins over the past 10,000 years, largely using stable isotope analyses, but also by microscopic identification of prey remains from ornithogenic soils. Ancient population trends have been reconstructed using a variety of approaches, from counting the abundance of occupied and abandoned colonies through time to the measurement of biogeochemical signals in sediments related to penguin activity. Here, we discuss how ancient DNA can provide a further tool for examining these trends; one which can overcome some of the limitations associated with previous approaches. We will also introduce a new research programme within the Ross Sea, where we will use ancient DNA to achieve two key aims: 1) to reconstruct diets of Adélie penguins over the last 8,000 years, identifying the composition of prey assemblages to species-level resolution; and 2) to measure changes in the genetic diversity of Adélie penguins as a proxy for population trends over the last 8,000 years.

92. WOOTTON, Tom

Adoptive rearing of a Humboldt penguin chick

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Abstract: In 2017 we successfully introduced a penguin chick from one pair to another. The penguin chick was undernourished and wasn't being fed by its parents.

We were able to remove the penguin chick and encourage another pair to begin rearing it. We had a plan in place which involved encouraging the foster parents to sit in their burrow ready for us to introduce the chick. They had reproduced that year but unfortunately had lost their eggs.

The chick was readily accepted, we monitored its progress as it was successfully reared by its foster parents. We hope to use this method in the future to encourage genetically important bloodlines or weaker breeding parents by adopting their eggs and chicks to foster parents.

93. YOUNG, Melanie

ELIGIBLE FOR STUDENT POSTER AWARD

Go forth and prosper? Post-fledging dispersal and the decline in juvenile survival of mainland yellow-eyed penguins

Authors: Melanie J. Young (1), Philip J. Seddon (1), Klemens Pütz (2), Thomas Mattern (1), Bruce C. Robertson (1), Yolanda van Heezik (1)

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Abstract: Juvenile survival is seldom quantified as a component of seabird conservation programmes because of study design issues including imperfect detection and long dispersal periods, which make the determination of juvenile mortality difficult. For mainland yellow-eyed penguins/hōiho (*Megadyptes antipodes*), historical evidence suggests stable juvenile survival and recruitment levels, but both parameters have declined over the past 35 years. With the anticipated localised extinction of mainland yellow-eyed penguins within the next few decades, identifying preventable causes of mortality during the juvenile dispersal period is critical. We tracked 30 juvenile yellow-eyed penguins during their post-fledging dispersal, over three breeding seasons, to determine their dispersal trajectory, and the presence of any spatiotemporal threats in hotspot foraging areas. Juvenile yellow-eyed penguins from the Otago coast dispersed into the Canterbury Bight after fledging, where penguin bycatch in commercial setnet fishing operations has been recorded. These findings have significance for primary industries and marine protection in New Zealand, and highlight the vulnerability of juvenile yellow-eyed penguins at this critical life-stage.
